

Chapter 4—Environmental Consequences



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Western kingbird

Luna Leopold (Aldo's son), was a leading geomorphologist and hydrologist who worked for the U.S. Geological Survey until 1972. In response to NEPA, he and others pioneered a tool (the Leopold Matrix) to identify the potential impact of a project on the environment. The system consists of a matrix with columns representing the various activities of the project, and rows representing the various environmental factors to be considered. The intersections are filled in to indicate the magnitude and importance of the impact of each activity on each environmental factor. Variations of this tool are still used today and in this plan.

(See Leopold, L. et al. 1971. A Procedure for Evaluating Environmental Impact. USGS Circular 645. 16pp.)

In this chapter we analyze the effects of continuing current management (the no-action alternative or alternative A) and of implementing each of the three action alternatives (alternatives B, C, and D). The environment that would be affected by the four alternatives is described in “Chapter 3—Affected Environment.”

The chapter provides information relevant to each impact topic and the methods used to analyze direct and cumulative effects. In accordance with the Council on Environmental Quality (CEQ) regulations implementing NEPA, a summary of the environmental consequences for each alternative is provided in table 11 in chapter 2. The resource issues and topics presented in this chapter, and the way in which they are organized, correspond to the resource discussions in chapter 3.

For more information on the guiding authorities, Federal laws, policies, and regulations providing a framework and process for evaluating the impacts of the alternatives considered in this EIS, please refer to “Appendix A—Key Legislation and Policies.”

4.1 Analysis Methods

In this chapter we analyze the impacts of the proposed changes to current refuge management by evaluating the no-action alternative (alternative A) and the three action alternatives (alternatives B, C, and D). We discuss the actions that may affect refuge resources under each resource topic, and the intensity of change resulting from those actions in all relevant contexts. In general, these are the consequences of the actions that we describe in “Chapter 2—Alternatives.” Some actions may affect several resources and may be simultaneously adverse for one resource and beneficial for another. For example, increased visitation to the refuge may have an adverse effect on the experience of solitude some visitors seek, but that same increase may have a beneficial effect on the local economy. Similarly, an effect may be adverse in the short term but beneficial in the long term. For example, loss of vegetation from prescribed fire may constitute a short-term adverse effect, while the long-term improvements in the quality and diversity of vegetation in subsequent growing seasons would be a benefit.

We analyzed the potential environmental consequences at various levels. The term “adverse effect” in assessing impacts under ESA and NHPA has a slightly different and specific meaning than it does under NEPA. We have been careful to note whether an impact on a listed species or a cultural resource is adverse under NEPA or one of these other acts. In our analysis we specified if the effects are direct, indirect, or cumulative—that is, in consideration of other actions being carried out or that could possibly be carried out in the foreseeable future by others. Our conclusions are also guided by the duration of an effect—whether it is of long or short duration.

Our analysis of the environmental consequences follows CEQ and DOI guidelines as well as Service NEPA policies. Our CCP and EIS interdisciplinary planning team reviewed literature and studies applicable to the region, the setting, and the resources being evaluated. We used this information to augment our onsite observations, as well the advice of internal and external resource management experts to support the qualitative and quantitative statements presented in this environmental consequences section.

Direct effects are those that immediately affect the resource and are the direct result of a specific action or activity. Direct effects are defined as those impacts that would occur immediately when the action causing them is taken. For example, the loss of vegetation associated with digging a new foundation or constructing a trail would be a direct effect.

Indirect impacts are those that occur either later in time or at a distance from the action that caused them. For example, breaching a dam at the refuge may lead to changes in the water quantity and quality downstream from the dam site.

Cumulative effects have been defined as “the impact on the environment which results from the incremental impact of our actions when added to other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such actions” (40 CFR 1508.7).

4.2 Analysis Approach

Our assessment was based on a variety of information, including public and private meetings and other communications with natural resource and other professionals, published scientific information, site inventories, agency reports, staff knowledge, public visitation and use data and projections (see appendix D), and computer modeling. Definitions of the following terms apply to our analysis of impacts.

Analysis Period—The draft CCP and EIS established the goals and specific implementation actions that we need to manage refuge resources for the next 15 years.

Analysis Area—The geographic study area for the EIS is the Rocky Mountain Arsenal National Wildlife Refuge, which is in Adams County between Commerce City, the community of Reunion, the neighborhoods of Montbello and Stapleton in the City and County of Denver, and DIA lands. The analysis area is fully described in table 5.

Duration and Type of Impacts—The CEQ NEPA regulations, which apply to all federal agencies, note that context, duration, and intensity are important factors in understanding an impact.

- *Context* can provide important comparative information when assessing an impact. For example, while the reintroduction of ferrets at the refuge may not add many individuals to the national population, it would be a substantial increase to the population in Colorado. Although geography is usually an important type of context analyzed in an EIS, the affected population, the agency

mandate, and the pristine or developed nature of the affected environment are other examples that may be relevant in fully understanding the intensity of an impact.

- *Duration* describes the length of time an effect will occur—either short or long term. Although the definition of each can vary for certain resources, we have generally applied the following in our analysis:
 - Short-term effects typically last up to 5 years.
 - Long-term effects last from 5 years to the 15- to 20-year lifetime of the CCP or longer.
- *Intensity* describes the strength or severity of the effect (either positive or negative) on the specific resources or the environment in general:
 - Negligible: an effect would be at the lower level of detection (such as less than 5 percent change from existing conditions).
 - Minor: an effect would be detectable or noticeable (such as somewhere between 5 and 25 percent change from existing conditions).
 - Moderate: an effect would be apparent (such as somewhere between 25 and 50 percent) and would have the potential to become major.
 - Major: The effect would be severe or, if positive, would have exceptional benefits.

Funding and Staff: The Service has defined each of the action alternatives to be reasonable—meaning they are economically and technically feasible. The costs of each and the staff they would require are not outside levels that other urban refuges have funded. However, funding cycles for any federal agency are subject to forces beyond the control of any one refuge, and fully implementing a selected alternative would depend on these cycles.

Plan Review may take place whenever new conditions or important new information influencing management becomes available. Generally, the lifetime of a CCP is 15 years.

We assumed that we will continue to follow standard operating procedures. We also assumed an increase in the number of visitors to the refuge based on our observations and data from current visitation trends and projections (see appendix D).

In the analyses, we address the potential impacts that are common to all alternatives for each resource topic. We then provide a discussion of specific subtopics that are related to the resource being addressed.

In analyzing the impacts, we used the best available science. Information included that from the scientific literature, Service and other agency reports, observations and projections by staff, and consultation with other staff and experts. To the extent possible, we used geographic information system (GIS) data from several sources, including other agencies, organizations, and researchers, to evaluate and calculate measurements. While GIS is a useful tool for evaluating and responding to queries, we realize that it may not be as accurate as a formal land survey. Consequently, discrepancies may exist. When sufficient or specific information was not available for us to assess the effects of an action, we used qualitative or relative assessments based on the scientific literature or professional field experience. Our analysis primarily relied on our staff's site-specific knowledge of the refuge and its resources and their own professional judgment to assess whether the impacts would be negligible, minor, moderate, or major.

Federally Listed and Candidate Species

The ESA (16 USC 1531 et seq.) requires that all Federal agencies consider the potential effects of their actions on species listed as threatened or endangered. If we determine that one of our proposed actions may adversely affect a federally listed species, we will initiate intra-Service Section 7 consultation (per ESA) with our ecological services' Colorado field office to ensure that our actions would not jeopardize the species' continued existence or result in the destruction or adverse modification of its critical habitat.

We used the following information to assess the effects of our proposed activities on federally listed species.

- Federally listed or candidate species found or likely to be reintroduced and that could be affected by the actions described under the alternatives.
- Habitat loss or alteration caused by the actions described under the alternatives.
- Displacement and disturbance potential of the actions and the species' potential to be affected by the activities.

According to ESA, the term “take” means to harass, harm, pursue, hunt, shoot, wound, kill, trap,

capture, or collect, or to attempt to engage in any such conduct. Table 16 shows the ESA definitions of the terminology used to assess impacts on federally listed species. The terms insignificant and adverse as used in the ESA determinations are not the same as the significance determination that may be made for NEPA purposes.

The biological opinion that we prepared for the possible reintroduction of the endangered black-footed ferret is included in this EIS as appendix F.

Assumptions for Increased Visitation

In 2013, the refuge received approximately 300,000 visits. Under alternative A, annual visits are expected to grow by approximately 2.3 percent each year, resulting in an estimated 420,000 annual visits in 2029. Under alternatives B, C, and D, visits are expected to grow by approximately 4.4 percent, 8.6 percent, and 4.7 percent annually, resulting in 2029 estimates of 575,000, 1.03 million, and 600,000 visits, respectively (USGS 2014b) (see appendix D).

Cumulative Impacts

The CEQ regulations for implementing NEPA require the assessment of cumulative impacts in the decisionmaking process for Federal projects. We have

considered cumulative impacts for the no-action alternative as well as for the three action alternatives.

One of the steps in analyzing cumulative impacts is to identify past, present, or reasonably foreseeable future actions that might contribute adverse or beneficial effects on the affected resource. This is the cumulative action scenario. Past actions are those that have been taking place since the establishment of the refuge, while reasonably foreseeable future projects are those that would occur within the life of the final CCP. Following CEQ guidance, we included past actions “to the extent that they are relevant and useful in analyzing whether the reasonably foreseeable effects of the agency proposal for the actions and its alternatives may have a continuing, additive, and significant relationship to those effects” (CEQ 2005).

The reasonably foreseeable actions and plans that we identified and considered in our cumulative effects analysis are listed in table 17. We have also included a brief discussion in chapter 2, section 2.8, of those foreseeable activities for which we have enough information to address in a meaningful analysis.

In general, our analysis of cumulative impacts followed the steps listed below:

- *Identify affected resources.* We used the list of affected resources as set out in “Chapter 3—Affected Environment” and “Chapter 4—Environmental Consequences” of this EIS to evaluate cumulative effects.
- *Set boundaries.* We identified boundaries for considering affected resources as described in table 5.

| Table 16. Endangered Species Act terminology. | |
|--|--|
| Term | Definition |
| No effect | When a proposed action would not affect a listed species or designated critical habitat. |
| May affect or not likely to adversely affect | When effects on listed species are expected to be discountable, insignificant, or completely beneficial—Beneficial effects are contemporaneous positive effects without any adverse effects on the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur. |
| May affect or likely to adversely affect | When any adverse effect on listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not discountable, insignificant, or beneficial—If the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, the proposed action “is likely to adversely affect” the listed species. If incidental take is anticipated to occur as a result of the proposed action, then it “is likely to adversely affect” the species. Incidental take is the take of a listed species that results from, but is not the purpose of, carrying out an otherwise lawful activity. |
| Is likely to jeopardize species or adversely modify critical habitat | The appropriate conclusion when the Service identifies an adverse effect that could jeopardize the continued existence of a species or destroy or adversely modify critical habitat of a species within or outside the action area |

Table 17. Reasonably foreseeable actions in the area of Rocky Mountain Arsenal National Wildlife Refuge, Colorado.

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| DIA and Denver Parks and Recreation: co-management of open space lands adjacent to the refuge |
| Continued expansion and development of Denver International Airport runways and other facilities |
| Highway 2: road work and maintenance |
| 56th Avenue Corridor Improvements (Quebec Street to Peña Boulevard) |
| 96th Avenue: Refurbishment |
| Refuge's Section 10: General development plan |
| Natural Resources Damages Assessment |
| Climate change |
| Climate change in Colorado |
| Climate change strategies for surrogate species |
| Climatic change policies |

- *Identify cumulative action scenario.* We determined which past, present, and reasonably foreseeable future actions to include for each affected resource. Reasonably foreseeable future actions include those Federal and non-Federal activities not yet undertaken, but sufficiently likely to occur, that a reasonable official of ordinary prudence would take them into consideration in reaching a decision. These activities include but are not limited to activities for which existing decisions, funding, or proposals have been identified. Reasonably foreseeable future actions do not include those actions that are highly speculative or indefinite (43 CFR 46.30).
- *Analyze cumulative impacts.* We summarized the effects of the actions under the alternatives to arrive at the likely total cumulative impact. We included the analysis for each of the resources that we identified.

4.3 Environmental Consequences for the Physical Environment

Geology and Soils

Alternative A

Currently, the refuge undertakes maintenance activities and habitat or wildlife management actions that may affect soils. For example, we construct

fences to keep bison in areas where we want grazing to occur. This action has both minor, localized, short-term adverse impacts on soils associated with the loss of soils during construction, as well as longer term adverse impacts associated with erosion. However, prairie restoration associated with bison presence would be a moderate beneficial effect. Management of our bison herd, requiring construction of additional fencing, will make more lands available to bison for grazing. The presence of bison on a wider area would potentially contribute to successful prairie restoration because soils may be fertilized and mixed by the bison's activity. Habitat restoration work conducted by the refuge under its newly approved HMP is expected to increase native prairie vegetation.

Breaching Upper Derby dam would have both a short-term adverse effect as the flush of water is released, as well as a long-term moderately beneficial effect by reducing erosion associated with the current fluctuating reservoir and overflows. The breaching would also have adverse and beneficial effects on soil characteristics—organic content, depth, porosity, density and compaction—by removing nutrients when the water is released, but adding nutrient-rich soils impounded by the dam.

Visitors parking off roads because of the lack of designating parking areas results in adverse effects on vegetation and underlying soils. Because we only carry out small-scale activities that entail no substantial change to the refuge's landscape, we expect no impacts on the site's geology.

Alternatives B, C, and D

The wildlife and habitat management actions described for alternative A and their effects on soils—both adverse and beneficial—would be continued under all the action alternatives. We are not proposing any major alteration of the landscape, and consequently we anticipate no effect on the geology of the site.

The action alternatives would disturb soils and change their organic content through the addition of black-footed ferrets. These would be moderate, adverse, and localized effects.

All action alternatives assume increased visitation (see appendix D) and use of trails, with the greatest increases projected under alternatives C and D. Because visitors would be largely restricted to trail use, most of this impact would be on built sites (such as fishing piers and docks, the Visitor Center, roads, and boardwalks); highly disturbed sites (like well-used lakeshore fishing spots); and dirt trails. This concentration of visitor activity minimizes the chance for additional soil loss from visitors walking, riding bikes, or driving at the refuge. Because some visitors would occupy new areas or leave trails, the potential for localized, minor to major adverse impacts from increased visitation would be part of any of the action alternatives, but particularly alternatives C and D. Our focus would be to design appropriate infrastructure to support increasing visitation with the goal of reducing visitor impacts on natural resources. Placement and construction of the small number of new enhancements would have a temporary adverse effect on soils and an overall negligible adverse effect. In addition, we are proposing abandoning many roads and incorporating reductions in the miles of the refuge's administrative roads we currently use (table 18). This change would have a minor beneficial effect on soils by reducing road use.

- **Alternative B:** In addition to the effects described for alternative A, 11.7 miles of roads would be abandoned and 8.5 miles of roads would be converted to emergency use only, resulting in a minor beneficial effect.
- **Alternative C:** Construction of eight new modest-sized parking areas and 11 miles of trails would have a negligible impact on soils. 14.5 miles of roads would be abandoned and 8.5 miles of roads would be converted to emergency use only, resulting in a minor beneficial effect. Modifying or burying distribution lines and improving the auto route from 56th Avenue would result in minor direct loss of soils.
- **Alternative D:** Construction of eight new modest-sized parking areas and 11 miles of trails would have a negligible impact on soils. 14.5 miles of roads would be abandoned and 8.5 miles of roads would be converted to emergency use only, resulting in a minor beneficial effect.

Water Resources

Alternative A

Water quantity and quality are among the most important considerations for the refuge's future. Water is also a very complex aspect of management. Our WMP (2014) describes our water rights, sources of water, and our future approach to water management. Continued habitat restoration will have a minor beneficial effect on water quality and quantity both on the refuge and for users downstream of the refuge.

The refuge's current policy of allowing natural surface flows to dominate is in keeping with Service policy to encourage natural conditions; this approach is a profound benefit to refuge water resources. Other beneficial practices include working with DIA and cities upstream of the refuge to manage stream and surface flow, and a refuge proposal to recycling all drinking water—a practice that could save 8 billion gallons of water per year. The refuge also maintains some dams and other water control infrastructure that, although not natural features, offer beneficial effects for wildlife by providing pond habitat.

Much of the water used by the refuge enters from the City of Denver in both the Irondale Gulch and First Creek basins. Overall, the quality of water flowing onto the refuge is generally good (Gordon et al. 2005). However, increased development surrounding the refuge could adversely affect water quality, and increased water quality monitoring will be needed in the future.

As evidenced by the September 2013 flood that damaged infrastructure in the refuge, urban drainage surrounding the refuge and its impact on the refuge will be an important issue into the future. Figure 14 shows how the flood extended the 100-year floodplain on the refuge. As required by current agreements, we will continue to work with the UDFCD and surrounding local governments on infrastructure improvements. Currently these improvements entail reconstruction of the Havana Pond dam and several other structures damaged by the flood. We will oversee the partial breach of the Upper Derby dam and will explore options for a refuge structure known as the Railroad Embankment, ranging from its removal to reconstruction of the embankment as a nonclassified dam (meaning it may hold some amount of water during extreme events, but will not hold enough water to warrant further consideration). Because the facilities are already in place, these minor alterations in their use and function would have only minimal temporary and long-term effects.

In June 2013, we completed formal consultation pursuant to ESA Section 7(a)(2) on the refuge's current and future use of water. This consultation required that we determine the source and any impacts associated with the use of up to 1,400 acre-feet water by the refuge each year for a wide variety of uses, and it concluded that our water use would not affect federally listed endangered species.

In April 2015, we completed formal consultation pursuant to ESA Section 7(a)(2) on the reintroduction of black-footed ferrets to the refuge. This consultation concluded that the proposal is not likely to jeopardize the continued existence of the ferret.

Alternatives B, C, and D

Water requirements and management would be the same under the action alternatives as under alternative A. In keeping with our WMP (2014), we would continue to prioritize conservation of water resources on the refuge. When needed improvements are completed by the U.S. Army (U.S. Army Corps of Engineers 2014), we will accept the transfer and management of the dams located on the refuge.

In keeping with 1987 USACE recommendations, the refuge will not accept any additional stormwater retention or runoff. We will continue to work with the UDFCD and surrounding local governments on improvements to existing facilities.

Air Quality

Alternative A

Maintaining significant, intact grassland habitat has a beneficial effect on air quality. Nevertheless, we believe that refuge management and visitation activities under alternative A would have a temporary, negligible, adverse effect on the existing air quality of the planning area and its surroundings. The projected increase in vehicular emissions from visitors to and staff of the refuge would temporarily affect the air quality parameters, but would quickly dissipate or would, for the most part, be absorbed by the vegetation of refuge habitats. The dust generated by visitors and refuge management activities would also have a negligible, temporary, locally adverse effect that would quickly subside as the dust particles settle back to the ground.

Alternative B

Air quality effects would be similar to those described for alternative A.

Alternatives C and D

The effects on air quality under alternatives C and D would be similar to but of somewhat greater magnitude than the same effects under alternatives A and B because of increased visitation and management activities. However, as described for alternatives A and B, vehicular and particulate emissions would quickly dissipate to the surrounding area under normal wind conditions and would be quickly absorbed and sequestered by the refuge's vegetation or, in the case of dust, quickly settle back to the ground.

Climate

Alternative A

As indicated in section 3.10, the projected growth and corresponding traffic congestion in the Denver Metropolitan area are expected to increase 40 percent by 2040, likely leading to an increase in carbon emissions in the area surrounding the refuge. However, none of the alternatives would entail an increase in roadway capacity. Consequently, the impacts of potential increases in visitation would have a negligible impact on air quality because any future emissions would be restricted by the current capacity.

Implementing habitat restoration as called for in the HMP would have a minor beneficial effect on the ecosystem through sequestration of carbon and additional habitat to increase resiliency of local ecosystems. We will also construct a new more efficient administration building and improve several other existing facilities that will receive a portion of their electricity from the new photovoltaic solar arrays planned for implementation at the refuge by 2018 (see "Sustainability" in "Section 2.2—Elements Common to All Alternatives"). Increased energy efficiency and sustainability measures for actions and facilities that support operations will provide a minor long-term beneficial effect by reducing carbon emissions. In addition, we will use the Service's recently issued CLIR tool to gauge greenhouse gas emissions and comprehensively assess, and over time reduce, the carbon footprints of operations and of our visitors.

Alternative B

The effects on climate would be the same as those described for alternative A.

Alternative C

We will increase visitor opportunities in new areas of the refuge and increase opportunities for both nonmotorized access and more energy-efficient methods of travel. Positive impacts associated with reductions in motorized use are likely to be offset by larger increases in overall visitation.

Alternative D

The effects on climate would be the same as those described for alternatives A and B.

Night Sky

Alternative A

Our current plans contain only limited information on visual resources and no discussion of night skies. However, continued implementation of these plans would have no additional impacts on the physical environment.

Alternatives B, C, and D

The refuge's natural setting makes it a notable asset in a large metropolitan community. We desire to protect night skies both for their aesthetic value and to reduce the effects of light pollution on wildlife. While the subtle effects of light pollution on wildlife (beyond several taxa such as sea turtles) remain largely unknown, it is well recognized that light pollution alters natural light regimes in terrestrial and aquatic ecosystems (Rich and Longcore 2005). Animals may either be attracted or repulsed by glare, affecting their foraging, reproduction, communication, and other critical behaviors. These changes then disrupt their interspecies interactions, with serious implications for community ecology (Longcore and Rich 2004). For example, artificial light affects the dawn activities of songbirds and can affect the timing of reproductive behavior (Kempnaers et al. 2010). Artificial light affects bats and other nocturnal animals by reducing their activity, thereby reducing travel distances and food consumption (Beier et al. 2006).

Our analysis has shown that some refuge areas should be targeted for preservation of night skies. We will work to remove existing, unnecessary nonnatural light sources in the refuge, providing a minor beneficial effect on aesthetics and wildlife. Limited evening programs will offer opportunities to experience a (fairly) dark night sky in a metropolitan environment, creating a beneficial effect on visitor experience.

Soundscapes

Alternative A

Current plans address the temporary noise impacts associated with the U.S. Army's final cleanup of the site. This work is now complete, and few proposed projects would entail a comparable level of noise. In the future, the majority of noise impacts on the refuge will originate outside the refuge boundaries. The continued operation and maintenance of the refuge requires the use of some vehicles and heavy equipment, but their use should have negligible, short-lived effects on the environment. However, increases in visitation without a plan of how best to accommodate visitors' travel through the refuge is likely to increase noise impacts.

Alternatives B, C, and D

Substantial research shows that noise affects wildlife (Turina and Barber 2011), and the impacts of chronic anthropogenic noise on wildlife vary by species and by intensity. In general, disturbance evokes anti-predator behaviors, interferes with other activities that enhance fitness, and can lead to population decline (Frid and Dill 2002). In addition, the effects of this type of stressor may be less obvious than would seem apparent. In general, humans on foot are more disturbing than motorized disturbance (Stankowich 2008). Large mammals like bison may spend less time foraging as they must take time to inspect their surroundings that they would otherwise spend searching for food (Fortin et al. 2004). Noise may affect the territory size of certain birds, and birds may be forced to compensate for noise by increasing the amplitude of their vocalizations (Brumm 2004). In fact, noise alone can reduce the richness of species in a given locale and can lead to different urban-adapted avian communities in and around human-altered habitats (Francis et al. 2009).

Based on the data provided, we will focus our attention on preserving the quietest areas of the refuge by limiting noise-producing activities. We will have limited abilities to control noise from adjacent lands, but will continue to remind neighbors of noise impacts on the refuge and its wildlife resources. Preserving quiet places and offering a quiet, natural retreat in an urban setting will result in a beneficial impact on the visitor experience of the refuge.

Cumulative Impacts on the Physical Environment

Alternative A

We are working with the City of Denver to ensure that management of stormwater on the new Section 10 lands (City of Denver lands adjacent to the refuge's southern border) is consistent with our management activities and the goals that we have set for the refuge. This new development south of the Visitor Center may have impacts that will be formally explored during the City's planning process. A well-developed long-term plan for regional stormwater is in the interest of the refuge, offering a minor beneficial effect in reducing the severity of property damage (both on and off refuge lands) resulting from storm events. Depending on the quality and quantity of stormwater runoff entering the refuge from neighboring areas, polluted runoff could have minor to moderate adverse effects on refuge resources. According to the final EIS developed for the construction of DIA (USDOT 1989), it is likely that DIA will continue to grow to its full capacity—which would include development of runways, associated infrastructure, and increased air traffic—within the life of the CCP. The USDOT final EIS describes the noise levels that existed during normal operations of the late Stapleton International Airport, the noise levels that were expected under normal operations for DIA's Phase I (i.e., current operations and noise conditions), and the expected noise levels when DIA would be fully developed and operated. According to our interpretation of the USDOT final EIS (1989) analysis of environmental consequences, the increase in noise levels, from Phase I to full development of DIA, that would impact the refuge's western boundary soundscapes would be minor (refer to figures in sections 5.8 and 5.11 of the USDOT final EIS), and, in our estimation, less intrusive than those that used to exist under normal operations of the late Stapleton International Airport (refer to the figure in section 5.4 of the USDOT final EIS). The presence of bald eagles and the diverse and thriving wildlife populations that have inhabited the refuge since Stapleton International Airport was in operation and through the current operation levels of DIA would indicate current noise levels have not deterred wildlife from continuing to use the refuge. Additionally, the USDOT final EIS contains mitigation actions (refer to section 5.55 of the USDOT final EIS) that would help ameliorate the detrimental impacts from the minor increases in noise levels from DIA's full development. We believe that, other than water resources and noise, no other cumulative impacts associated

with current plans and activities in the areas surrounding the refuge would affect geology and soils, air quality, climate, or night sky.

Alternatives B, C, and D

As described for alternative A, there would no cumulative impacts, with the possible exception of stormwater runoff associated with Section 10 and those to soundscapes associated with increased air traffic as DIA expands its infrastructure and operations.

4.4 Environmental Consequences for the Biological Environment

Habitat

The refuge recently completed its HMP and accompanying environmental assessment (FWS 2013a) and is already implementing it. The decisions made in the HMP are no longer open for public comment, and implementation will continue regardless of the alternative selected. Relevant decisions are summarized here and elsewhere in this EIS to provide context. Because the HMP would continue to be implemented under all alternatives, the discussion for alternative A also pertains to the action alternatives. The discussions of the action alternatives only addresses those issues where specific effects differ from those under alternative A.

Alternative A

In keeping with the HMP, we will continue to identify and implement specific treatments necessary to restore and maintain shortgrass and mixed-grass prairie. These treatments include seed plantings, prescribed fire, grazing, mowing, and methods to address the threat of invasive plants and noxious weeds.

Continued implementation of the FMP (FWS 2013i) will ensure that refuge habitats undergo necessary prescribed fire treatments to support habitat restoration, invasive plant species control, and necessary fuel reductions. Additional information on the effects of fire on plants and wildlife species can be found in the 1997 environmental assessment and

FONSI (see appendix C of the Fire Management Plan) for the FMP.

Riparian habitats throughout the Great Plains are extremely important to wildlife. The HMP outlines goals and strategies to establish baseline conditions and plant replacement of cottonwood trees on the refuge. These efforts, in conjunction with treatment of invasive plants, will result in substantial beneficial effects on native plant species on the refuge.

Inventory of riparian habitat could lead to control of invasive species with moderate benefits in improving habitat. Continuing partnerships with agencies for restoration activities could have a moderate beneficial effect on habitat. Over time, improvements in habitat related to existing staffing would become more apparent with moderate benefits for habitat quality and extent of native habitat.

While woodlands may provide some habitat for woodland bird species (which were not historically present on the refuge site), these woodlands and locust thickets—currently dominated by cheatgrass—fragment grassland habitat and provide predator perches, resulting in adverse effects on grassland-nesting birds. Our staff spends considerable time and resources trying to reduce cheatgrass infestation.

Alternative B

Increased visitation could result in off-trail use, leading to trampling of native habitats in localized areas. Trampling initially bends and weakens leaves and branches and ultimately breaks them. It directly damages plants by reducing photosynthetic surfaces, seed production, and carbohydrate reserves. Although off-trail use may be infrequent, the greatest increase in damage to plants from trampling occurs at a low intensity—between the first 100 and 300 passes (Joslin and Youmans 1999). Still, because the increase in visitation is not expected to be as high under this alternative as other action alternatives, impacts are likely to be localized, vegetation is likely to recover each spring, and overall effects would be negligible or minor.

Some loss of soils and vegetation that serve as wildlife habitat could result from small-scale construction, new trails, burying transmission lines, and other actions such as installing and maintaining split-rail boundary fences. These activities are common to the action alternatives and would result in temporary localized minor or moderate effects. Vegetation would return in the spring following construction. All action alternatives include removing some of the section line roads, possibly adding habitat with negligible benefits.

An indirect impact on wildlife habitat could result from reintroduction of black-footed ferrets (common

to all action alternatives). If successful, ferret reintroduction could mean a negligible reduction in black-tailed prairie dog populations. Restoration of shortgrass and mixed-grass prairie habitats is considered the primary habitat goal at the refuge, because these habitats provide important stopover spots for migrating birds and other wildlife. To some degree, disturbance of habitat over the years has resulted in a very high prairie dog population, a condition that prevents successful restoration of prairie habitat (FWS 2013h). A more balanced prairie dog population resulting from the reintroduction of ferrets could have widespread minor to moderate beneficial effects on prairie habitat on the refuge.

Alternative C

In addition to the effects described for alternative B, visitation under this alternative is expected to be about double that under alternative B, and the adverse impacts of off-trail use could be more severe, ranging from minor to moderate. Social trails may be created if trail users frequently attempt to access a desirable location by walking off designated trails. If so, vegetation could be permanently lost. At high visitor use levels, the additional spread of invasive plant species by visitors transporting propagules—for example, on shoes, clothing, bicycle tires, and packs—may become problematic. However, because the refuge is already subject to high levels of infestation by invasive nonnative species, the impact compared to current conditions would likely be negligible. Also, alternative C includes efforts to educate the community and visitors about impacts on wildlife and habitat from actions such as off-trail use. A specific targeted effort to inform hikers or bikers would also greatly mitigate impacts of off-trail uses.

Alternatives C and D include the construction of eight new smaller parking areas and 11 miles of trails. Because these facilities would be constructed mostly along existing two-track roads or in prior disturbed areas, the impacts on habitat at the refuge are likely to be localized and minor.

Alternative C also calls for a greater expansion of the number of visitor amenities and facilities than other alternatives. The long-term effect of these facilities would be to reduce the quality of adjacent habitat and to remove habitat in the features' footprints. Because most of these would be created near or even in the footprint of existing structures, impacts would be minor.

We would also abandon 14.5 miles of roads (approximately 105 acres), and 8.4 miles of roads (approximately 62 acres) would be converted to emergency use only. We would choose to abandon roads that provide the greatest extent of habitat connectivity and scale, such as roads that bisect a large block

of intact habitat. These abandonments and conversions would result in a minor beneficial effect because they would revert to native landscape, improving habitat conditions for wildlife populations.

Opening the Wildlife Drive to public vehicles would have a minor effect on habitat along the roadsides because it could reduce the quality of habitat through disturbance and increased introduction and spread of invasive species. Making trail connections with trails outside the refuge to bring more visitors could result in minor adverse effects on habitat through fragmentation, disturbance, and the introduction of invasive species. Increased efforts to inform the community about native plant communities could mitigate these impacts, but the extent of this benefit is unknown.

Alternative C calls for the removal of overhead power lines and burying them. Undergrounding power lines would have a minor, long-term beneficial effect by improving nearby habitat; however, installation activities would have a short-term adverse effect.

Increased stocking may induce more fishermen to apply for fishing permits; at the same time, because increased fishing permit fees might also discourage existing fishermen, the net effect could be inconsequential. However, if fishing pressure increases, there could be a moderate, adverse effect on wildlife habitat along shorelines through trampling and increased fragmentation associated with heavier use.

Overall, fragmentation effects on habitats would be primarily limited to already disturbed sites. While fragmentation does affect the overall health and biodiversity of an ecosystem, improving large areas of habitats and preventing further loss—actions that would be implemented in keeping with the HMP under any CCP alternative—are of greater importance than reducing fragmentation (Fahrig 2003).

Alternative D

Impacts on habitat associated with visitation would be similar to those described for alternative B. Impacts associated with new trails and parking lots would be similar to those described for alternative C. Large events under this alternative could cause moderate, short-term adverse effects through disturbance such as trampling of vegetation. Increased outreach and education programs would have a greater beneficial effect than under alternative C through explaining the beneficial values of native ecosystems, but the extent of this benefit is unknown.

Alternative D calls for a more extensive trail system than described for alternative C, and connections between the refuge and other areas would be a focus. Although trails on the refuge would not be more numerous than under alternative C, the connection



Toad

Cindy Souders / USFWS

with other locations may exacerbate the transmission of invasive species either to or from the refuge.

This alternative calls for increased partnering and collaboration with agencies, the public, and academia. Sharing knowledge, data, and activities could improve management of the refuge and increase knowledge of topics such as habitat fragmentation and carrying capacity in a fenced environment. These effects would be beneficial and wide-spread, ranging in intensity from minor to major.

Wildlife

In addition to effects on wildlife habitat, we analyzed impacts on both diversity and populations. The analysis of impacts on animal populations focuses on large-scale impacts, such as birth and death rates, health, and behavior. However, impacts on populations are made up of impacts on individuals. Animals may experience impacts directly from disturbance or displacement. Wildlife responses to disturbance are shaped by six factors:

- the type of activity;
- predictability of the activity;
- frequency and magnitude of the activity;
- timing (such as breeding season);
- relative location (such as above or below the activity on a slope); and
- the type of animal (for example, size, habitat requirements, group size, sex, age) (Knight and Cole 1995).

Impacts on individual animals can be reflected in a population if the impacts are severe enough, resulting in changes to population size, fecundity (that is, reproductive capacity), or health. Community-level impacts—such as species diversity—may also result.

More often, other dynamics that affect populations and communities—such as habitat loss or climate variables—obscure noticeable impacts from individual actions like those described under the CCP alternatives, although such impacts may be occurring nonetheless.

The analysis of impacts on wildlife considers several factors, such as differences in conditions and management between the refuge's prairie management zone where bison are confined, and the Environmental Education Zone in the southern portion of the refuge. In the prairie management zone, the HMP calls for the use of four surrogate species to assess impacts. Impacts on these four species are indicative of impacts on habitat and the ecosystem in this area. Consequently the wildlife analysis overlaps considerably with the habitat analysis because the approach of using surrogate species is intended to evaluate impacts on grassland habitat as well as the species that depend on it. Across the entire refuge, but particularly outside the bison area, a more generalized analysis—one that addresses fish, herptiles, birds, and mammals as classes—is helpful in understanding the effects of disturbance. Because the HMP would be implemented under all alternatives, the analysis focuses primarily on the management effects associated with aspects of visitor use that would vary under the action alternatives. Accordingly, effects associated with the practices and objectives set forth in the HMP are most heavily discussed under alternative A.

Alternative A

Species of Concern

Ferrets would not be introduced under this alternative, and no management efforts to protect them or to help establish a population would be implemented. No beneficial effects on this species would occur at the refuge under alternative A.

The inventory of riparian habitats is an ongoing activity that takes place in habitat occupied by bald eagles during certain parts of the year. Impacts from disturbance during the surveys have been and would continue to be avoided by conducting them outside the breeding and winter roosting season.

The HMP calls for removing existing bat boxes originally intended for the big brown bat. This species is not listed, but is considered in assessing mammalian diversity, a factor whose importance is of increasing concern to wildlife managers (FWS 2013a). Removing the boxes is not expected to have any effect on this or other bat species at the refuge, because they have never been observed to be used since they were first installed in 2005.

The HMP identifies Swainson's hawk, burrowing owl, and grasshopper sparrow as species of concern because they currently breed on the refuge or could breed here in the future (in light of future habitat restoration), and because they are exhibiting declining population trends. The refuge supports a robust population of burrowing owls as well as nesting Swainson's hawks, and it may reemerge as a breeding area for grasshopper sparrows. Habitat goals and objectives in the HMP include creating vegetative mosaics of different seral stages in the prairie and grassland communities to support existing and potential future breeding. Implementation of the final CCP over its 15-year horizon would likely have refuge-wide benefits, ranging from minor to major depending on the pace and success of habitat restoration.

Surrogate Species

The highest priority goal in the HMP is to restore and maintain more than 10,000 acres of shortgrass and mixed-grass prairie to provide habitat for the four surrogate species—Cassin's sparrow, lark bunting, black-tailed prairie dog, and American bison—and the species for which they are surrogates (such as grassland birds). Fragmentation of habitat—mostly associated with urbanization and development—is considered a primary cause of the decline of grassland bird populations. The HMP points out the importance of maintaining both a large, intact, and unfragmented prairie grassland and a structurally diverse habitat modified by the natural processes of bison grazing and prairie dog activity. Continued management of bison and prairie dog populations will help to keep these two key species in a healthy balance.

Lark buntings are area-sensitive and require large tracts of undisturbed grassland for breeding. Restoring 4,500 acres of shortgrass prairie to high quality habitat as proposed in the HMP is expected to provide substantial benefits for buntings and associated species, including Swainson's hawks. Establishing 8,000 acres of high-quality mixed-grass prairie is expected to provide similarly important benefits for Cassin's sparrows and associated species, including grasshopper sparrows and foraging Swainson's hawks. Additional pasture for bison proposed in the HMP would potentially result in more than 12,000 acres of grazing land, with major localized benefits for this species. Each of these HMP actions has already been incorporated into the planning process and will be implemented as funding becomes available over the lifetime of the CCP.

Fish

Fish and other aquatic or semiaquatic species use the reservoirs and riparian areas on the refuge. The



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Western meadowlark

reservoirs (Lake Mary, Lake Ladora, and Lower Derby Lake) are currently managed to balance populations of largemouth bass, bluegill, and northern pike with other species and to provide recreational catch-and-release fishing opportunities. These areas and riparian lands also provide foraging habitat for bald eagles and migratory habitat for waterfowl and shorebirds. We have found some imbalances in the refuge's fish populations, such as larger catfish and smaller bass and bluegill. The HMP sets specific objectives for each sport fish species in each lake to rebalance size and abundance.

Herptiles

No specific management of reptile or amphibian populations is spelled out in the HMP. Because these species are not monitored, information about their relative health or population trends on the refuge is not available. However, in many locations in the Rocky Mountain region, factors such as the presence of nonnative species (including bullfrogs, which prey on native amphibian eggs, larvae, and adults); elevated nitrogen levels (such as from fertilizers upstream); or increased turbidity or contamination from roads or from the management of invasive species with chemical herbicides, may be adversely affecting native species (Maxwell and Hokit 1999). In the HMP, we propose managing lake water quality to maintain minimum dissolved oxygen and maximum water temperatures, actions that would indirectly offset some of these effects on native herptiles. Over the lifetime of the CCP, these improvements could provide minor or moderate benefits for amphibians and other aquatic species throughout the refuge.

Roadkill of slow-moving reptiles and amphibians occurs now, even with relatively few vehicles on the roadways in the refuge. This effect is likely to increase as visitation increases. Restrictions on road access may keep roadkill from rising at the same rate as visitor use, and impacts are likely to be no more

than minor under alternative A. Enhancement of visitor access can also modify habitat use by creating migration barriers and by decreasing breeding, foraging, and overwintering habitat (Maxwell and Hokit 1999).

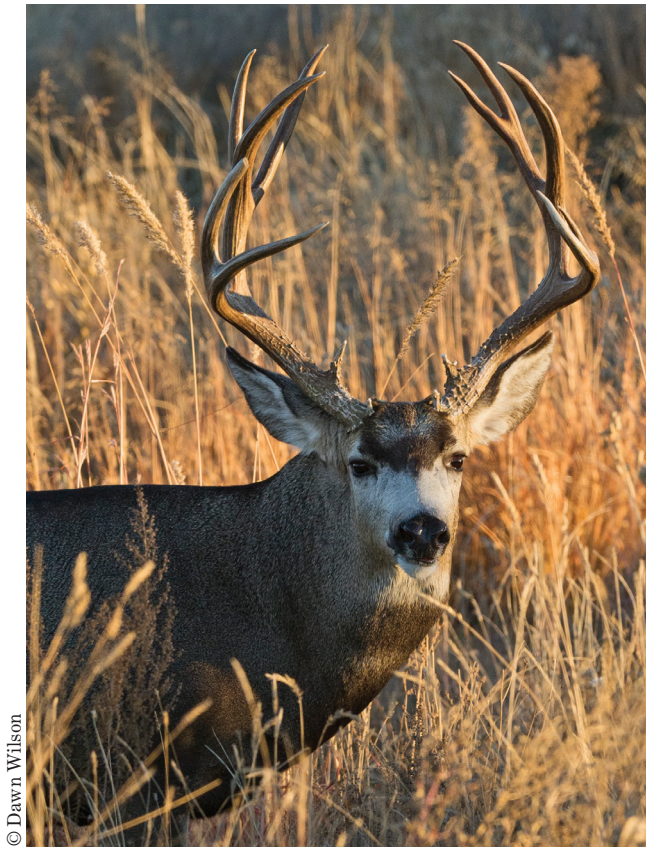
Birds

The vegetation at the refuge is used by a wide variety of birds, including those that primarily inhabit shortgrass and mixed-grass prairie, shrublands, woodlands, and riparian and wetland areas. A representative sample of bird species and the type of habitat they occupy is shown in table 12, and a list of species is available in appendix G. Woodland (including riparian forest) and wetlands on the refuge support many species of waterfowl, shorebirds, wading birds, neotropical migrants, and other species such as woodpeckers and jays. The refuge does not contribute substantially to habitat for these latter species, and the HMP focuses restoration and management efforts on grassland species. However, water quality goals identified for lakes, riparian monitoring, and ongoing restoration of woody riparian vegetation along First Creek as described in the HMP would keep the habitat from becoming degraded and continue to provide benefits similar to those currently available.

Birds exhibit many responses to human activity, from habituation to abandonment. Disturbance can be particularly problematic for birds when it disrupts important behaviors such as feeding or breeding. Grassland-shrubland and savannah songbirds may be vulnerable to disturbance from cars or bikes on the road or from people using trails. During the breeding season, effects on birds can include nest desertion, predation, premature fledging, and separation of adults from young. When bird activity concentrates in migration or overwintering habitats, disturbance can change foraging habitats and decrease efficiency of food consumption for energy (Hamann et al. 1999). At least one research team (Miller et al. 1998 as cited in Hamann et al. 1999) found lower nest survival for grassland birds adjacent to hiking trails in Colorado. The presence of a road or trail can create edge habitat that allows access by predators. Johnson and Temple (1990) found predation on nesting grassland birds to be higher in fragmented than in contiguous tallgrass prairie.

Bald eagles can be quite sensitive to disturbance. Depending on the type, intensity, duration, and location of disturbance, as well as the point in the nesting cycle when the disturbance occurs, they can completely abandon a nest or even eggs or chicks (MBEWG 1994 as cited in Hamann et al. 1999).

The refuge does not host a large population of breeding waterfowl, marshbirds, or shorebirds. Nests or broods that have been found on the refuge



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Mule and deer, confined within the refuge by a perimeter fence, heavily utilize the southern half of the refuge.

include pied-billed grebe, mallard, American coot, redhead, northern pintail, blue-winged teal, gadwall, northern shoveler, ruddy duck, killdeer, and American avocet. Nonbreeding waterfowl, shorebirds, or wading birds may be flushed from feeding or resting areas or may change food habitats, feed only at night, lose weight, or desert the feeding area, although not all waterbirds are equally sensitive to disturbance. Some may habituate to a distance from ongoing disturbances (such as people fishing).

A predicted 40 percent increase in visitor use over the 15- to 20-year lifetime of the CCP would exacerbate existing adverse effects of human use of the refuge. Effects would remain localized but would increase in severity, perhaps to minor or moderate levels.

Mammals

Small mammals, ungulates, and carnivores can be adversely or beneficially affected by human activities. Since these groups are highly interconnected (mainly by the food they consume), it is understandable that changes to their habitats (fragmentation) or populations (for example, through hunting) can have substantial impacts on an entire ecosystem (Canfield et al. 1999; Hickman et al. 1999). For some species of small mammals, such as porcupines, rabbits, and

voles, the mere presence of humans may have adverse effects (Hickman et al. 1999). At least one study (Mainini et al. 1993 as cited in Hickman et al. 1999) found that the presence of hikers could adversely affect the time spent and success of foraging.

Currently, the refuge is closed to hunting and winter sports such as cross-country skiing. Consequently, the primary source of impacts on ungulates (deer and bison) and carnivores (both meso-predators such as skunks and raccoons and larger predators like coyotes) is likely to be vehicles and hikers. Many species spend much of the warm season accumulating fat reserves and supporting young of the year. Mule and white-tailed deer, confined within the refuge by a perimeter fence, heavily utilize the southern half of the refuge, especially in winter. Deer obtain some nutrients in riparian areas and other wet sites, which are scarce at the refuge. Disturbance by hikers or anglers in these locations can be particularly harmful as it may disrupt important feeding or drinking. Adult deer may shift foraging or bedding areas if trail or road use is intense, resulting in unnecessary energy expenditures that are detrimental in both winter and summer. Does may be forced to leave fawns hiding near trails for prolonged periods if human use is extensive. If disturbance persists, ungulates may return only at night or abandon these areas altogether. This can result in the loss of energy for both does and their fawns, particularly if deer move to less productive areas.

Deer and other mammals often manage the threat from recreationists by maintaining a distance between themselves and humans, cars, bikes, roads, or trails. Time of day (morning or evening) and wildlife group size may be significant in predicting response distances. Mule deer alert distance was greater in the evening, but bison flight distance and the distance mule deer moved from disturbances were greater in the morning. Furthermore, bison, deer, and pronghorn reaction was the same to a hiker as to a bicyclist. While animals recognize the human form of a hiker, it is the speed of the bike and not the form of a human that makes cyclists less predictable to wildlife (Taylor and Knight 2003). Currently, visitation at the refuge likely has minor and temporary effects on deer. Closing the refuge at night and low visitation numbers in the early morning likely offset the impact. Under alternative A, the projected increase in visitation is consequently not likely to increase effects on deer beyond minor and localized levels.

Deer populations at the refuge are surveyed regularly but are influenced primarily by natural forces such as fawn predation by coyotes and harsh winters. However, refuge staff may periodically cull deer to maintain desired herd size and structure. Bison are

currently managed by forage and water availability. The Service has reserved the right to cull bison if necessary in the absence of the ability to transport live bison out of the refuge (see HMP). These management tools would continue to provide beneficial effects on ungulates by maintaining healthy herds.

Generally, carnivores such as skunks, raccoons, and coyotes have adapted to the presence of humans and human recreation (Claar et al. 1999). These species are likely to be affected only in localized areas of heavy recreational activity, human presence, or development, such as at the Visitor Center and around the fishing lakes.

Alternative B

Generally, alternative B would entail fewer new trails than alternatives C or D. With the exception of activities associated with reintroduction of black-footed ferrets, wildlife management would be similar to that under alternative A.

Species of Concern

The Service's Recovery Plan goal for black-footed ferrets is to establish free-ranging ferrets totaling 1,500 breeding adults in 10 or more populations in at least 6 of 12 states within the species' historical range (FWS 2013k). Ferret reintroduction on the refuge would contribute to the recovery of the species by allowing captive-raised ferrets to be acclimated to natural conditions and potentially establish a naturally self-sustaining population on the refuge. If the reintroduction is successful, it would aid the overall recovery of the species with the ultimate hope of delisting from ESA protection. Any excess ferrets born at the refuge would be used to help in reintroduction efforts at other refuges or public lands where requested by the relevant land management agency. If the refuge reintroduction is successful enough to help in starting populations across a broader region, the beneficial effect of moving toward the Recovery Plan goal could be wide-ranging and moderate. If the reintroduction effort is confined to the refuge, benefits would be localized and may only be minor in contributing to the nationwide recovery goal. However, the beneficial effect on the native prairie ecosystem of reestablishing this key species would be moderate or even major on the local scale.

Under alternative B we would restrict public access in the black-footed ferret reintroduction area to increase the success of the reintroduction. The Wildlife Drive would only be used by refuge staff and for guided public tours, reducing traffic disturbances for many prairie species during migration, wintering, and breeding seasons. Low traffic volume would also help in minimizing road kill of ferrets. Additional benefits for ferrets may result from visitors viewing

the live ferret exhibit that is part of the action alternatives. Viewing the exhibit and learning about black-footed ferrets and their place in a natural prairie ecosystem would increase the desire on the part of the public to support their reestablishment and protection. However, released ferrets and their offspring may be subject to mortality from natural factors (such as predators, adverse weather conditions, disease) and unintentional human factors. Unintentional mortality can include deaths associated with equipment, fire management, prairie dog control, roadkill, and the handling of the ferrets themselves. Furthermore, ferrets that disperse off the refuge may be subject to take (harm or loss) for a variety of reasons, including but not limited to loss of habitat due to development and fatalities caused by domestic animals, collisions with vehicles, and animal control activities necessary to maintain the safe operation of DIA. However, loss of these animals would not jeopardize the species because the animals likely to disperse would be excess to the essential population on the refuge and would be genetically redundant with the refuge population. Additional information on the findings under the Endangered Species Act for ferret reintroduction is available in appendix F.

Alternative B (and all the action alternatives) includes examining the feasibility of reintroducing three species of concern to the refuge: plains sharp-tailed grouse, greater prairie chicken, and pronghorn.

The plains sharp-tailed grouse is one of four species of North American grouse (collectively known as prairie grouse) that inhabit a broad range of plant communities dominated by grasses and shrubs, where males engage in communal breeding displays. Six extant subspecies and one extinct subspecies are recognized (Del Hoyo et al. 1994). In Colorado, the Columbian sharp-tailed grouse, also known as the mountain subspecies, has undergone a significant range-wide decline. The second Colorado subspecies, plains sharp-tailed grouse, is listed as endangered in the state. Historically this species was found in steppe, grassland, and mixed-shrub habitats throughout much of central and northern North America (Connelly et al 1998). Lekks form a hub of breeding habitat and usually occur on elevated areas, such as knolls, ridgetops, or openings surrounded by sagebrush with recommended buffer zones of 1.25 miles (Hamann et al. 1999). The species formerly nested over much of the northern two-thirds of the eastern prairie, but the present population consists of only a few hundred birds in Douglas County. The decline is the result of overgrazing and the conversion of grassland to cropland and, more recently, to housing developments. What remains of Colorado's population is now severely threatened by proposed land developments in the area between Denver and

Colorado Springs (CPW 2014). A draft management plan for the reintroduction of plains sharp-tailed grouse to the refuge prepared in 2005 (FWS 2005) noted that although the refuge could offer suitable habitat for the species, several factors—such as utility lines, fences, predator populations, and habitat management tools—might deter successful reintroduction. It is unknown where on the refuge they may establish, but the habitat around leks, nesting sites, and brood-rearing areas would require enhancement and protection from human disturbance. Fences built to extend bison grazing pastures could fragment habitats for prairie grouse if the fences provide perch sites for raptors or the grouse inadvertently fly into them. These fences would be installed 18 inches above ground level to allow passage of wildlife (including pronghorn). The Wildlife Drive would only be open to staff and to the public on guided tours, precluding further adverse effects associated with disturbance. If reintroduction is successful, the addition of plains sharp-tailed grouse to the refuge prairie ecosystem could be a moderate or even major beneficial effect.

The greater prairie-chicken is a species of prairie grouse that occupies midgrass sandsage in sandhills. Ideally, greater prairie chickens should be managed on a broad landscape basis with a primary focus on nesting and brooding areas. In much of the current fragmented range, booming grounds have become the focus of management efforts because the majority of year-round locations are within 1 mile of booming grounds (Anderson and Toepfer 1999; Westemeier and Gough 1999). Birds using fragmented grasslands (for example, fragmented by woody plant invasion and conversion of intervening lands to unsuitable habitat) may experience greater predation rates than those using more expansive grassland habitats. Winter roosting habitat consists of shelterbelts and other woody vegetation along cropland edges or drifted snow (Manske and Barker 1988). If it is successful, the reintroduction of the greater prairie-chicken to the refuge prairie ecosystem could be a moderate or even major beneficial effect.

Pronghorn have been a historic component of North America's grasslands and have created a niche for themselves in remaining habitats. Pronghorn inhabited lands adjacent to what is now the refuge in the twentieth century, and can consequently be considered a lost species to this ecosystem. In 2010, the "Pronghorn (*Antilocapra americana*) Reintroduction and Management Plan" was drafted, examining the feasibility of bringing pronghorn back to the refuge. A compatibility evaluation listed six potential pronghorn management concerns: fencing, genetic viability, disease transmission, interspecific competition, supplemental winter feeding, and population management. If it is successful, the reintroduction of

pronghorn to the refuge prairie ecosystem could be a moderate or even major beneficial effect.

The proposed trail to the east side of Upper Derby Lake would be seasonal under alternative B (and all action alternatives) to minimize disturbance to resting bald eagles.

Surrogate Species

Increased visitor numbers would result in some disturbance and could cause grassland birds such as Cassin's sparrows and associated species (such as grasshopper sparrows and foraging Swainson's hawks) to avoid grassland habitat. This type of impact is described in more detail below in "Birds," but the adverse effects are not likely to be more than moderate in intensity under alternative B or the other action alternatives.

Bison may move away from roads, but they would otherwise be less affected by increased visitor numbers than other species because their habitat is fenced and trails or bikes would not be allowed.

If successful, reintroduction of ferrets is likely to have an impact on prairie dog numbers. Black-tailed prairie dogs are an important component of the ecosystem at the refuge. Although the number of prairie dogs at the refuge fluctuates, it is high enough to hinder current prairie restoration efforts. For example, the extent of prairie dog colonies expanded from 1,814 acres in 2007 to nearly 3,100 acres in 2009 (FWS 2013a). To help reduce numbers, the refuge supplied prairie dogs to the BFF Center to assist in their captive breeding program. In our Black-Tailed Prairie Dog Management Plan (FWS 2013h), we indicate that reestablishing ferrets would add a natural predator component to the prairie ecosystem, resulting in beneficial effects on prairie ecology, the stability of the prairie dog population, and our ability to continue to restore prairie habitat for all native wildlife. The impact of a single ferret on the prairie dog population can be impressive, as their metabolism runs high and prairie dogs make up about 90 percent of their diet (Clark 1986). For example, a study published in 1983 (Stromberg et al.) estimated that one adult female black-footed ferret with a litter requires 474–1,421 black-tailed prairie dogs per year for sustenance. The authors concluded that this dietary requirement would require 91–235 acres of black-tailed prairie dog habitat for each female black-footed ferret with a litter. The numbers, ages, and sex ratio of ferrets to be introduced at the refuge would be decided following approval of a CCP alternative that includes ferret reintroduction, but the population dynamics would be carefully modeled and designed to ensure maximum success and a balanced prairie dog population size.

Bald eagles, hawks, and other wildlife that feed on prairie dogs would experience some adverse effects

from the loss of prey if ferret reintroduction is successful. In addition, monitoring efforts associated with ferrets would include the use of nighttime spotlighting surveys for ferrets in prairie dog zones, some of which are near the bald eagle nesting area. This potentially adverse effect would be temporary but could be of moderate intensity.

Fish

Impacts on water quality associated with increased visitor use would be similar to those described for alternative A but more severe, because both foot and vehicle traffic could increase. Additional visitors to lakes and streams may leave food or trash that could wash into these aquatic systems. Fishing levels would remain essentially the same under alternative B as described for alternative A.

Herptiles

Because access and restrictions would be largely the same as under alternative A, only the projected increase in visitation would have any effect on herptiles. There would be an increased risk of roadkill on those roadways open to vehicular traffic. Because visitor numbers are expected to increase, the resultant levels of activity could have minor, localized adverse effects on amphibians and reptiles, especially along trails.

Birds

As noted above, disturbance from humans can result in increased energy expenditures; disruption of feeding, breeding, rearing, or other important behaviors; and displacement and abandonment of nesting or resting sites. While disturbance could affect individuals or small groups of birds at the refuge, no impacts would be extensive enough to affect populations.

The refuge supports several species of wintering diurnal raptors (golden eagles, rough-legged and ferruginous hawks) that may flush from foraging sites or loafing perches in the vicinity of year-round trails or roads. Nesting raptors on the refuge include the great horned owl, long-eared owl, burrowing owl, red-tailed hawk, and Swainson's hawk. Currently, most of these birds reuse historic nest sites, providing some predictability of the impacts of specific trails and roads. Known nocturnal raptor roost sites (primarily those of eagles) are somewhat protected by road closures and the refuge's closure after dark.

As visitation increases, some raptors experience increased adverse disturbance effects. For example, burrowing owls may seasonally use prairie dog burrows from April through September.

Tree-nesting raptors, including great horned owls, red-tailed hawks, and Swainson's hawks, currently show tolerance of visitors on nearby trails in

the Environmental Education Zone (see HMP), but as visitor numbers grow, these birds may move nesting locations to areas farther from existing trails and human disturbance. These effects are not expected to be more than minor unless visitors leave existing trails and approach nest sites, in which case the effect could increase to a moderate level of intensity on occasion. However, raptors roosting or nesting in trees along the riparian corridor could be subject to nighttime disturbance associated with spotlighting surveys conducted for black-footed ferrets. These disturbances would be intermittent and of short duration but could constitute adverse effects of moderate intensity.

As noted above, waterbirds may be less tolerant of human activity than other types of birds. A study of wintering waterbird distribution on the Ding Darling National Wildlife Refuge (Klein et al. 1995) showed that reactions to human disturbance varied with species, migrant status, and disturbance type (vehicle or pedestrian) and intensity. Migratory waterbirds were more sensitive to humans than were resident populations. Birds adjusted their distance from the disturbance source (road or trail) depending on their tolerance level. Foraging shorebirds and dabbling ducks requiring shallow water were the most severely affected.

At the refuge, resting or feeding waterbirds near reservoir perimeter trails or those close to lake or riparian areas may be flushed by pedestrians during migration if the water is not frozen. Trail use along reservoirs could also affect nesting waterfowl and shorebirds by flushing females off the nests, exposing eggs to environmental conditions and predators. Shoreline activities such as fishing would potentially have adverse effects on waterbirds as well as on species that use shoreline vegetation such as blackbirds, sparrows, and warblers. Alternative B, like all the action alternatives, would include environmental education about roosting and nesting activity to minimize disturbance. Signage proclaiming Sensitive Wildlife would help identify areas where visitors should take extra precaution.

Other bird species could be affected by visitors hiking on trails in the woodlands and prairies. Miller et al. (1998) found that the composition and abundance of birds in both forest and grassland ecosystems were altered adjacent to trails, with habitat-edge species more common than habitat-interior species in the vicinity of trails. Furthermore, the human disturbance associated with trails caused some species to avoid the trail areas entirely.

Habitat fragmentation and its effects on migratory grassland-dependent birds is an important issue for many of the species that occupy habitat on the refuge. In the Front Range of Colorado, urban expansion has meant the loss of extensive areas of

native prairies, leaving remaining tracts small and isolated. In this context, the thousands of acres of prairie habitat the refuge offers can be extremely important in supporting grassland species. However, development of visitor facilities, trails, and roads at the refuge can segment this habitat, and to the extent that additional roads, trails, or other facilities are created as part of action alternatives, could have localized adverse effects on grassland birds that require extensive and unbroken habitat.

Riparian species also need intact vegetation along stream corridors for successful roosting or feeding. Hutto (1998) noted that the fragmentation of riparian habitats within human-created corridors had a greater impact on songbirds at a landscape level than division of adjacent forests. On the refuge, such impacts on songbirds would occur on the half-mile section of the First Creek Multiuse Trail near the southeast corner of the refuge. Although there may be more severe localized impacts on individual migratory riparian birds, the impacts on populations would be negligible.

Mammals

The effects on mammals described for alternative A would also occur under alternative B, although to a greater degree because of projected increases in visitation.

The repair and reopening of the Rattlesnake Trail and completion of the Perimeter Trail would bring visitors closer to habitat and provide a corridor for smaller mammals to leave the refuge and be subject to road kill.

Alternative C

Alternative C would entail the most extensive expansion of visitor facilities and services of the action alternatives. In addition, trails and associated parking lots connecting the southern exterior of the refuge with the lakes area inside the refuge (figure 10) would be constructed. Wildlife management would be similar to that under the other action alternatives.

Species of Concern

Generally, the effects of reintroducing ferrets and possibly other native species would be similar to those described for alternative B. However, once these species are reintroduced, we anticipate that visitor viewing, surveying, road traffic, and other human disturbance would have adverse effects on species of concern. These impacts would be most severe under alternative C because visitor use is anticipated to more than triple existing levels.

Impacts on ferrets would be potentially less severe than those on other reintroduced species

because ferrets are nocturnal and the refuge closes at sunset. Although the Wildlife Drive would be open to public vehicles, we do not expect any impacts on ferrets from this action because ferrets are nocturnal. However, other reintroduced species could be disturbed by additional car traffic in the vicinity, as well as by visitors stopping in pull-outs and leaving their cars to move closer to observed wildlife. For pronghorn, such disturbances could be particularly adverse because they are shy and maintain large distances from people or cars when they can. Road traffic also acts as a barrier to crossing by pronghorn and prairie grouse and functionally fragments habitat for these species, decreasing carrying capacity. Adverse effects could be locally moderate.

Surrogate Species

The increased presence of trails and parking lots, including the addition of a new trail, overlook, and access point in the northeast corner of the refuge, would have adverse effects on ground-nesting grassland birds, including the lark bunting and Cassin's sparrow. Increased disturbance during the breeding season could reduce successful reproduction of these species, as well as limiting habitat availability and their relative abundance. Opening the Wildlife Drive to public access and the development and use of additional pull-outs would likely drive grassland birds away from this source of disturbance, essentially reducing breeding and feeding habitat for some individuals. These adverse effects could be widespread and moderate.

Opening the Wildlife Drive would have negligible effects on bison and prairie dogs. These prairie species' reproductive success will not likely be influenced by vehicular presence. However, they may alter their foraging behavior, moving away from the disturbance of traffic.

Fish

Although alternative C proposes an increase in fishing licenses, clinics, derbies, and classes, all these programs would continue to be catch and release. Although these activities may result in adverse effects on a few individual fish, overall effects on fish populations would be negligible or minor. With increased visitation, siltation from increased use of new and existing trails leading to the lakes as well as increased contaminant runoff from roads could result in adverse effects on water quality. Because visitor numbers would be highest under this alternative, effects on fish habitat could be locally minor or moderate.

Herptiles

The type of impacts described for alternative A would be considerably more severe under alternative

C because of increased visitor use and access. The addition of new trails and parking lots, opening the Wildlife Drive, and opening portions of the refuge to bicyclists would substantially increase the risk of roadkill, particularly for amphibians near water bodies during the breeding season. Increased car access would also increase the probability of contamination of amphibian habitat by contaminated runoff from roadways. Increased trail use could contribute to increased sediment discharge, causing elevated turbidity in refuge lakes. Disturbance from visitor use along trails or near lakes or riparian areas would also be an adverse effect. These conditions would be likely to result in moderate localized adverse impacts on herptiles.

Birds

Birds would be subject to the types of impacts described for alternative B. However, the expanded facilities and access proposed under alternative C would have additional adverse effects. The introduction of cross-country skiing in habitat that has traditionally been left undisturbed during winter could have locally minor to moderate adverse effects on some species if it disrupts their efforts to accumulate necessary energy for overwintering.

The addition of trails and visitor use on them may influence nest site selection, particularly along the Discovery, Uvalda Ditch, Highline Canal, and Peña trails. The addition of bicycles could disturb tree- and ground-nesting bird species and create additional fragmentation if birds are hesitant to occupy habitat near this new source of disturbance. Bicycle traffic on the Uvalda Ditch and Highline Canal Trails may cause some nest abandonment or mortality of nest occupants. Depending on the degree of use and location of bike paths, these adverse effects could range from minor to moderate intensity. This effect would be exacerbated by an increase in private vehicle traffic along the shared portion of the Wildlife Drive. Collectively, these impacts are likely to be widespread, although they are unlikely to exceed moderate intensity.

Although the Wildlife Drive road system intercepts some prairie dog towns in Sections 22, 27, and 30 that are used for nesting by burrowing owls, this species is tolerant of vehicles on set roadways and is not expected to experience more than negligible additional effects from increased vehicle use. Similarly, Swainson's hawks, which have nested in trees bordering many existing refuge roads without detrimental effects, are not expected to experience more than minor adverse effects from the planned northern roadway, provided that traffic does not stop directly underneath nest trees.

The addition of trails near the lakes would bring additional visitors to habitat where shorebirds,

waterfowl, and other semi-water-dependent birds rest and nest. In combination with increased fishing and visitor facilities near the water, adverse effects on these relatively sensitive species could be locally moderate. Furthermore, vehicles using the Legacy Loop and Wildlife Drive could disturb ducks and geese coming into nighttime loafing areas of open water at Lake Ladora, Lower Derby Lake, and wetland areas. This could be a particular disturbance at sunset when visitors are likely to be exiting the refuge at closing time. The proposed wildlife observation blind and accompanying parking area on Lower Derby Lake may concentrate the noise disturbance for birds, while alleviating the visual deterrent.

Construction of a new entry and administrative complex, as well as other more minor construction projects, would create noise and likely result in avoidance by birds. These impacts would be temporary and are not likely to be more than localized and minor.

Mammals

Because of increased visitation, facilities, access, and associated human activities, the impact mechanisms described above for alternative A would affect mammals to a much greater degree under alternative C.

Vehicle-mammal collisions are more likely to occur with the opening of the Wildlife Drive, especially when the refuge is open past sunset (as in the case of special events). Disturbance from trail use, including cross-country skiing during winter, could have adverse effects on energy expenditures in mammals attempting to feed, an important activity during the cold months.

Deer may be particularly subject to disturbance and could experience moderate localized impacts on a regular basis. Access to foraging and water during the day when visitors are using the trail or occupying lakeshore or riparian habitat may be reduced or eliminated, causing animals to relocate.

The introduction of bicycle traffic would cause some mammals to run from disturbance, which in turn would drain energy reserves and could disrupt feeding or caring for young. This would be a new and potentially minor to moderate adverse effect on mammals.

Alternative C includes the possibility of a deer-hunting program for youth and people with disabilities. Currently, the refuge deer population is stable, but the HMP calls for maintaining a healthy herd. Allowing unregulated growth of this and other species in the fenced and finite habitat of the refuge could jeopardize the condition of animals in the herd, may increase the incidence of disease, and would jeopardize native prairie and shrubland habitat restoration. The HMP briefly examined the option of an

archery hunt for removing excess deer and found it to be an option we should explore further. Alternative C anticipates a hunter education program that would be required before archers are allowed to hunt. Although it is likely that a youth hunt with new archers would not be as effective in reducing deer numbers as staff culling, overall the impact on the deer population would be minor.

Alternative D

Alternative D would be largely similar to alternative C with regard to facilities and access, although the Wildlife Drive would be open to two-way traffic.

Species of Concern

The effects on black-footed ferrets and other reintroduced native species of concern would be similar to those described for alternative C, but their severity would be less because visitation is not expected to be as high.

Working with other agencies to expand the range of the black-footed ferret under alternative D would have a range-wide beneficial effect, but the magnitude of this effect is unknown.

Surrogate Species

The effects on surrogate species would be similar to those described for alternative C, although because visitation is anticipated to be lower, the intensity of the effects would be lower.

Opening the Wildlife Drive to two-way traffic for visitors' vehicles would potentially affect prairie dogs and bison by altering foraging behavior, but the intensity of this effect would be negligible.

Fish

Alternative D includes the potential to raise fishing fees, promote fishing opportunities on other public lands across the state, and increase refuge stocking rates. These changes would be paired with expanded programming, including advanced fishing classes. The combination of education and a catch-and-release fishery would minimize losses to the fish populations at the refuge, and impacts would be negligible or minor. Impacts from siltation related to trail use and contaminant runoff from roads and parking lots would be similar to those described for alternative C, although they might be of somewhat lesser magnitude because of the anticipated lower level of visitation.

Herptiles

The effects would be similar to those described for alternative C. However, because alternative D is anticipated to result in a lower level of visitation than alternative C, the magnitude of these effects would

be similarly lower. The siltation and degradation of aquatic habitat associated with disturbance, erosion, and contaminant runoff would constitute a localized minor to moderate adverse effects.

Birds

In addition to the effects on birds described for alternative C, alternative D would include two large annual events on the refuge. Such activities could displace birds and other wildlife at least temporarily. Although such disturbances could be of moderate intensity, they would be of very short duration.

Mammals

The effects on mammals described for alternative C—potential collisions, disturbance from increased pedestrian use, and the addition of bikes and cross-country skiing—would also occur under alternative D, although to a lesser degree because of the lower anticipated level of visitation.

Cumulative Impacts on Biological Resources

Habitat

Many local organizations and governments are working on habitat conservation in areas bordering or near the refuge, such as the Sand Creek Greenway, Barr Lake State Park, and the Prairie Gateway Open Space. We anticipate that these areas will continue to have beneficial effects on the natural environment, providing improved habitat conditions for wildlife. However, wildlife habitat remains at risk as urban sprawl and development continue. The refuge will become more of an island of native grassland and shrublands, providing a niche of ever increasing importance in an urban setting.

Wildlife

Species of Concern

The scope of the refuge's black-footed ferret recovery program is limited to areas within the refuge boundary. However, if the recovery is highly successful, some ferrets born in a given year may be relocated to seed reintroduction efforts on other public lands at the request of the managing agency. Over time, reestablishing ferrets in a wider region could contribute substantially to the Service's Recovery Goal for this species.

Pronghorn would be confined to the refuge by the perimeter fence and cattle guards and would therefore not be affected by outside cumulative effects. However, prairie grouse may fly over the fence. These species would benefit from any natural conservation efforts undertaken on adjacent land tracts or corridors.

Future residential and commercial development outside the refuge would be detrimental to the sustainability of prairie grouse populations.

Surrogate Species

The lark bunting and Cassin's sparrow may be beneficially affected by any conservation efforts on adjacent land tracts, but not by expanded corridors or trails as both are area-sensitive species. The co-management of specific parcels of wildlife habitat would benefit grassland bird species by increasing the amount of high-quality habitat inside the refuge fence, thereby decreasing fragmentation.

Bison could benefit from the Service's co-management of Denver Parks and Recreation open space lands east of the refuge. However, the bison may choose not to use that area if the disturbance factor from the adjacent trails and overlook become excessive. Currently, the prairie dog population on this property may limit the availability of forage.

Fish, Herptiles, Birds, and Mammals

Wildlife may use some of the existing agricultural plantings outside the refuge for forage.

Residential and commercial development along the eastern and northern refuge boundaries would be detrimental to riparian wildlife species outside the refuge as well as in areas co-managed by the refuge and Denver Parks and Recreation. Excessive disturbance would adversely affect bat foraging areas and songbird nesting sites. Water quality and flow in First Creek may be adversely affected by further development along the banks, especially with increased runoff from artificial structures.

4.5 Environmental Consequences for Visitor Services

Hunting

Alternative A

There would be no effect because hunting would not be allowed. Management of wildlife populations would be accomplished through other methods.

Alternative B

The effects under this alternative would be the Service's and CPW's staff time necessary to carry out a limited, special use hunt (for example, field preparation, hunting zone signage, safety zone signage, hunting brochures, hunter compliance checks, hunter education classes). All hunting would take place in areas closed to the general public, thus minimizing both sound and safety effects on visitors and surrounding neighbors. A 1,000-foot safety buffer around the refuge perimeter would be established (figure 18) to minimize potential impacts or conflicts with activities outside refuge lands. Additionally, a 500-foot safety buffer would be established around all public use refuge roads, minimizing conflicts with other visitors. Some wildlife species may be temporarily displaced by hunter presence and noise disturbance. Hunter access would be allowed only by foot—except for those requiring increased accessibility—thereby minimizing disturbance to wildlife. Shotgun noise during the dove hunts could temporarily displace wildlife in the immediate vicinity of the hunted area. The quiet nature of archery for deer hunts would minimize disturbance of wildlife and neighbors.

This very distinctive opportunity would provide a beneficial effect for visitors interested in hunting. The access for young and disabled metropolitan area residents to be exposed to a new wildlife-dependent recreation, the ability to train in a convenient location, and a high probability of a successful harvest are all benefits not typically associated with an urban environment. Because hunting would require the closure of the refuge to the public and other visitors, there would also a short-term adverse effect.

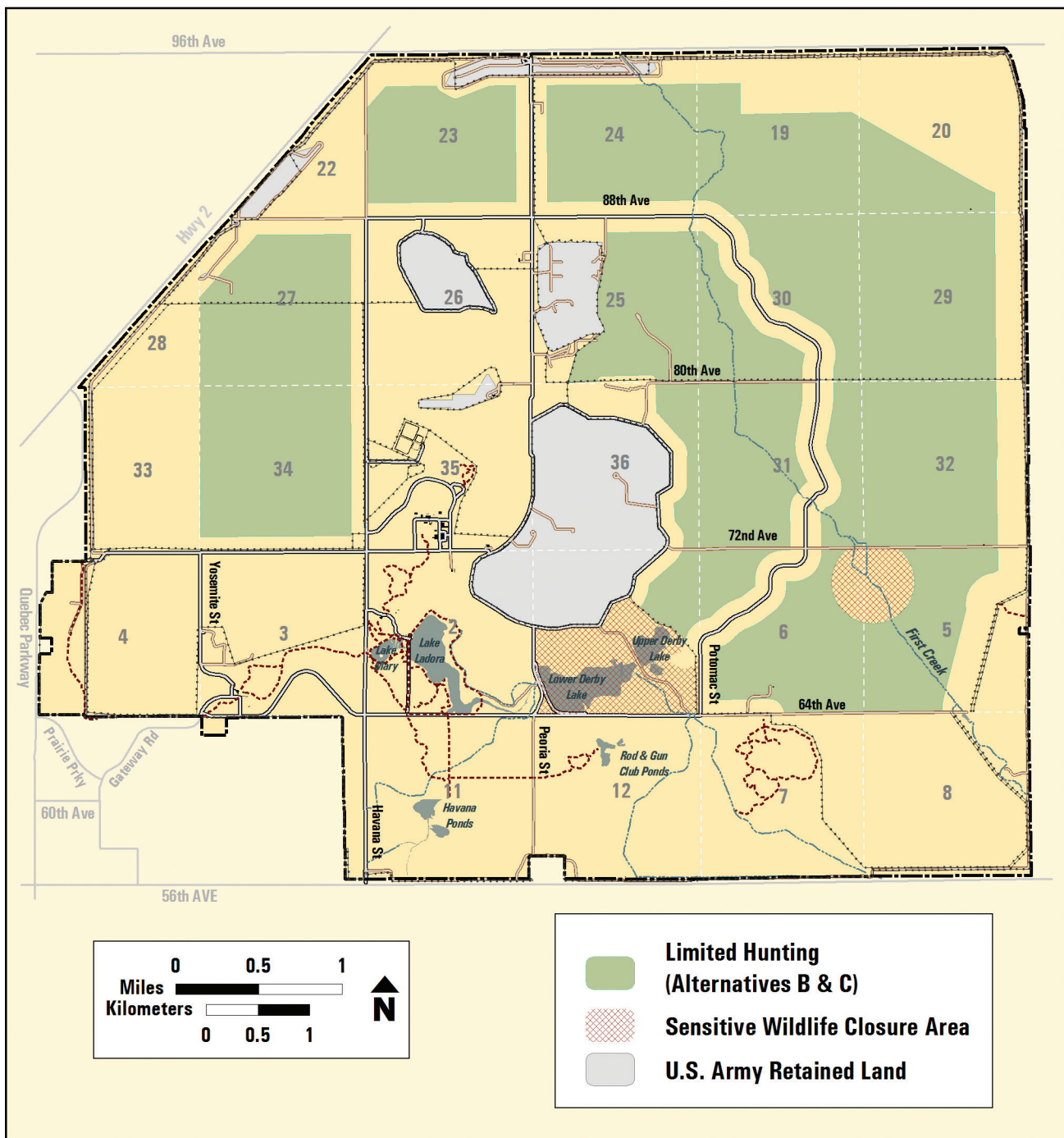


Figure 18. Proposed limited hunting areas on Rocky Mountain Arsenal National Wildlife Refuge, Colorado.

Alternative C

The effects under this alternative would be similar to those under alternative B, but the addition of an archery range would provide additional opportunities to educate and instruct youth on archery and hunting ethics. This would yield a minor, positive, long-lasting benefit to the public.

Alternative D

The effects under this alternative would be similar to those under alternative A, but we would promote hunting opportunities throughout Colorado and the Refuge System.

Cumulative Impacts on Hunting

There would be no cumulative effects under alternative A. Hunting is only proposed under alternatives B and C. While hunting has impacts on individual animals, because of the limited scope of the proposed hunt program, we anticipate no cumulative effects on populations because State and Federal regulations ensure population viability for regionally and nationally hunted species.

Effects on Fishing

Alternative A

Some fish mortality may result from handling fish after the catch and from fish swallowing hooks or lures. Fish may experience hook injuries when they are caught multiple times. Nonfishing days should provide sufficient healing time to reduce this consequence. Aquatic plants or shoreline vegetation may be trampled or disturbed by wading or shoreline fishing. An increase in litter around the shoreline can be expected as fishing pressure increases. Prohibition of live bait in the reservoirs should reduce litter. Some fishing line may be tangled in trees or lost in the reservoirs, leading to fish and bird mortality around the reservoirs. Monofilament line recycling stations are available at each reservoir open to fishing. Continued public access to fishing would continue to have long-lasting beneficial effects on the visitor experience.

Alternatives B, C, and D

Increased visitation, instructional programming, and public access to fishing would have long-lasting beneficial effects on the visitor experience, but would also cause increased fishing pressure on the refuge's

fisheries and would have long-term adverse effects on wildlife access to fishery resources compared to those effects under alternative A. These effects would be more pronounced as visitation increases, with alternative C resulting in the most severe effects, followed by D and B in descending order.

Expanded instructional programming for fishing and beginner-level facilities under alternatives C and D would facilitate skill-building and interest in wildlife-dependent recreation. By creating opportunities to introduce visitors to fishing and building their comfort and skill level with these new endeavors, alternatives C and D would have a substantial long-term beneficial effect. Under alternative B, fishing opportunities would remain essentially unchanged from current management direction.

Cumulative Impacts on Fishing

Because we are not changing fishing regulations and activities, nor are we expecting to carry out activities that would directly affect the water quality of the refuge reservoirs, we anticipate no cumulative impacts on fishing or fisheries.

Effects on Wildlife Observation and Photography

The natural setting of the refuge and more than 350 species of wildlife provide outstanding wildlife observation and photography opportunities. Our goal is to enhance and maintain habitats for diverse wildlife species. Nature trails and facilities provide visitors with unique opportunities to view wildlife year-round. Improvements to interpretive media, programs, trails, and facilities would enhance visitor experience.

Alternative A

No changes are proposed to the visitor experience. Because the refuge is not designed to sustain current or projected visitation, increased visitation could have a major adverse effect on the visitor experience. The lack of pull-outs and parking areas throughout the refuge can lead to traffic congestion. Some of our trails may be too long for visitors with mobility impairments or with small children, and some sections of our trails are closed due to flood damage. Our current staff size and volunteer availability create challenges in accommodating the current volume of tours.

Alternative B

This alternative involves minor to moderate changes that would have moderate beneficial effects on the visitor experience. Added facilities, a minor to moderate increase in programs, and the reintroduction of native species would also have a moderate beneficial effect on the visitor experience.

Alternative C

This alternative proposes major increases of facilities, expanded programming, and the reintroduction of native species, resulting in major beneficial effects on the visitor experience. Direct, increased visitation would have a minor adverse effect on some visitors' experiences. This alternative substantially expands visitors' opportunities by providing new wildlife observation facilities and trails and allowing new modes of transportation: bicycle riding, cross-country skiing, and jogging. Connecting refuge trails to surrounding communities and off-refuge trails will have major beneficial effects of increasing access to the refuge for wildlife viewing and photography. This increased access may result in an increase of new and nontraditional visitors to the refuge. There is also a

potential for minor to moderate adverse effects associated with possible conflicts resulting from multiple modes of transportation sharing the same trails. Conflicts may arise as the mix of users may have different paces or interests; for example, bikers and joggers could clash with hikers, small children, or visitors with limited mobility. Some users may be distracted by talking, using cell phones, or viewing wildlife, reducing their reaction time when encountering other trail users. Signs to educate visitors about wildlife observation and trail ethics may help mitigate these conflicts. There is also the potential for bicycling on nature trails to disturb both wildlife and visitors seeking to view wildlife. Overall, the beneficial effect of increased opportunities would be enhanced by the purposeful effort specified under this alternative to engage a more diverse audience with the importance of conservation and the beauty, fun, and ecological intricacies of wildlife.

Alternative D

Effects under this alternative would be generally similar to those described for alternative C. Partnerships would be developed with other organizations to provide photography instruction, and concessionaires would conduct fee-based wildlife viewing tours. Allowing concessionaire tours would provide visitors with more frequent tour opportunities and provide a financial benefit to local companies. Some visitors may object to paying fees for a tour and may opt to visit the refuge in their private vehicles.

Cumulative Effects on Wildlife Observation and Photography

Alternative A proposes no changes to programs or facilities and would have negligible effects on the visitor experience. There would be no cumulative effects.

Alternative B proposes minor changes to programs and facilities and would have minor beneficial effects on the visitor experience. Accordingly, we expect minor beneficial cumulative effects by increased viewing opportunities, and minor adverse cumulative effects on the visitor's ability to see wildlife because of the increase in visitation.

Alternative C proposes major increases to programs and facilities and would have moderate to major beneficial effects on the visitor experience. Accordingly, we expect moderate positive cumulative effects by increased viewing opportunities, and minor adverse cumulative effects on the visitor's ability to see wildlife because of the increase in visitation.



Cindy Souders / USFWS

Opportunities for wildlife photography abound on the refuge.

Alternative D proposes major increases to programs and facilities and would have moderate beneficial effects on the visitor experience. Accordingly, we expect minor positive cumulative effects by increased viewing opportunities, and minor adverse cumulative effects on the visitor's ability to see wildlife because of the increase in visitation.

More wildlife observation and photography programs and facilities under alternatives C and D could result in a substantial increase in visitation. More visitors and crowding on trails and within facilities could detract from visitors' solitude and reduce opportunities to see wildlife. However, more convenient access to the refuge interior and more viewing facilities and programming would present increased opportunities for wildlife viewing, nature study, experiencing the outdoors and natural areas, and learning the techniques of wildlife observation and photography, resulting in a long-term beneficial effect on the visitor experience.

Effects on Environmental Education

Alternative A

The habitat and wildlife of the refuge offer outstanding environmental education opportunities. Our goal is to enhance and develop conservation education for present and future generations. Improvements to programs and facilities will enhance visitor experience and awareness.

Under alternative A, there would be no changes to the environmental education program. However, because of limited staff we would be unable to lead the level of requested environmental education programs, resulting in a moderate adverse effect on environmental education.

Alternative B

Minor changes to programs and facilities are proposed. New curricula, particularly taking advantage of the new live black-footed ferret exhibit, would be developed, resulting in minor beneficial effects on environmental education. Visitors would have new opportunities to learn about and understand the significance of the refuge system as well as the refuge wildlife and habitats.

Alternative C

Moderate to major changes to programs and facilities are proposed. In addition to the improvements described for alternative B, programs under this alternative would seek to build comfort levels for nontraditional users, promote conservation education in the communities, and increase the use of technology to connect with broader audiences. The development of a new Education Center and wildlife exhibits would enhance environmental education learning experiences. The reintroduction of native species would offer increased opportunities for education regarding the prairie ecosystem. The expanded educational programming, additional tours, and new interpretive media proposed under this alternative would result in substantial long-term beneficial effects on environmental education.

Alternative D

Moderate to major changes to programs and facilities and moderate are proposed. In addition to the effects described for alternative C, alternative D would further expand environmental education programs and increase collaboration with universities to provide adult education. Concessionaire-led tours may provide even more opportunities for guided tours, thereby increasing the beneficial effects on environmental education. Additional learning opportunities focused on the refuge's history and culture (such as living history programs and rehabilitated historic structures) would expand the range of interpretation and add to the beneficial effects on environmental education.

Cumulative Effects on Environmental Education

Alternative A proposes no changes to programs or facilities and would have negligible effects on environmental education. There would be no cumulative effects.

Alternative B proposes minor changes to programs and facilities and would have minor beneficial effects on environmental education. We expect minor beneficial effects on environmental education associated with the addition of the live ferret exhibit.

Alternative C proposes moderate to major increases in programs and facilities and would have substantial long-term beneficial effects on environmental education. We would expect moderate to major beneficial cumulative effects on environmental education through increased participation.

Alternative D proposes moderate to major increases in programs and facilities and would have

substantial long-term beneficial effects on environmental education. We would expect moderate to major beneficial cumulative effects on environmental education through increased participation.

Effects on Interpretation

Alternative A

The habitat and wildlife of the refuge offer outstanding interpretation opportunities. Our goal is to enhance visitor learning and awareness about the refuge and the Refuge System. Improvements to interpretive media, programs, and facilities would enhance the visitor experience.

Under alternative A, no changes to interpretation programs and facilities are proposed.

Limited staffing and reliance on volunteers to meet the demands for interpretive programs would remain a challenge. We rely on volunteers to staff the front desk of the Visitor Center from Wednesday through Sunday and to conduct nature programs. Service funds to cover costs of the volunteer program are minimal and station funds are required to cover the costs of uniforms. If station funds are further reduced, it may reduce or eliminate programming, resulting in a major adverse effect on interpretation.

Alternative B

Minor changes to interpretation facilities and programs are proposed. The effects would be similar to those described for alternative A, except that adding a new live ferret exhibit and interpretive program would result in a minor beneficial effect on interpretation.

Alternative C

Moderate changes to facilities and major changes to programs are proposed. Expanding the scope of interpretive programs and materials to better meet the needs of visitors (such as self-guided interpretive opportunities, increased interpretive media and programs, working with partners to develop multilingual programs, providing interpretive programs offsite, and expanding interpretive opportunities through social media) would have a major beneficial effect on interpretation.

Alternative D

The effects of this alternative would be similar to those described for Alternative C, with an increased

focus toward linking regional sites. Accordingly, there would be a major beneficial effect on interpretation.

Cumulative Effects on Interpretation

Alternative A proposes no changes to programs or facilities and would have adverse effects on interpretation associated with funding shortages. There would be no cumulative effects.

Alternative B proposes minor changes to programs and facilities and would have minor beneficial effects on interpretation. However, there would be no cumulative effects.

The cumulative effects under alternatives C and D would be the same as those under alternative B.

4.6 Environmental Consequences on Cultural and Historical Resources

There are four primary concerns regarding cultural resources on the refuge: preservation of significant resources, unanticipated discoveries, artifact curation, and research and interpretation of sites and artifacts. These are reviewed below to determine the environmental consequences of each alternative.

Alternative A

Significant Resources

Significant sites, buildings, and structures would be protected from adverse effects by construction and visitation. Continued repairs and stabilization of the Egli House, maintaining it in a state of arrested decay, would yield a minor benefit for this historic structure. The roof has recently been replaced and the windows and dormers are being repaired while maintaining as much of the original style as possible.

Unanticipated Discoveries

If previously unrecorded cultural resources are discovered they will be evaluated and managed in accordance with Section 106 of the National Historic Preservation Act, avoiding adverse effects.

Artifact Curation

Artifacts are stored under conditions that sometimes meet legal mandates but often do not. We would also attempt to solicit outside expertise concerning the proper cleaning and storage of items, leading to a moderate to major improvement in stor-

age and curation. The possible deaccession and transfer of some artifacts would be explored and could be a substantial improvement over current conditions.

Research and Interpretation

Research on sites and artifacts would be minimal. Some interpretation of these resources would continue to be conducted on tours of the refuge. We would continue to display and interpret World War II and Cold War history in the Visitor Center. We would attempt to find qualified individuals or organizations to expand our understanding and the interpretation of these items.

Alternative B

Significant Resources

The effects on significant resources would be the same as described for alternative A. Potential future refuge developments, including a new administrative complex, bunkhouse, pipelines, trails, and entrances, would have minor or no adverse effects on significant resources.

Unanticipated Discoveries

The effects pertaining to unanticipated discoveries would be the same as those described for alternative A.

Artifact Curation

The effects pertaining to artifact curation would be the same as those described for alternative A.

Research and Interpretation

In addition to the effects described for alternative A, we would interpret prehistoric uses of native habitats and landscapes, resulting in a moderate beneficial effect.

Alternative C

Significant Resources

In addition to the effects described for alternative B, increased public visitation in areas with significant archaeological sites or to the Egli House would necessitate increased monitoring of those areas. In the case of the Egli House, the effects of retrofitting the building for public use would be negligible if appropriate historic preservation standards are followed. We would restore the exterior of the Egli House, yielding a major preservation benefit beyond that under alternative B.

Unanticipated Discoveries

In addition to the effects described for alternative B, the development of additional administrative or visitor facilities would increase the likelihood of unanticipated discoveries during construction and through increased public use of the refuge.

Artifact Curation

Possible additional artifact storage under this alternative would result in major beneficial effects on the preservation and storage of these items.

Research and Interpretation

Improved artifact storage would result in moderate to major improvements for potential research and interpretation opportunities. Similarly, increased public outreach would increase the refuge's visibility, in turn offering minor to moderate benefits for interpretation of cultural resources. The establishment of partnerships with Native American communities would have a moderate to major beneficial effect on interpretation of cultural resources on the refuge and in surrounding areas. We would introduce more guided interpretation of currently unidentified historical resources that would be suited for outdoor storage and display, leading to a minor to moderate beneficial effect on interpretation of cultural resources.

We could provide interpretation and access to additional information on the prehistory and history of the refuge through the use of electronic media.

The restoration of the exterior of the Egli House and garage would substantially increase the value of the property for tours, resulting in a moderate beneficial effect on interpretation.

Alternative D

Significant Resources

In addition to the effects described for alternative C, both the exterior and the interior of the Egli House would be restored to its period of significance, resulting in a major preservation benefit.

Unanticipated Discoveries

The effects under this alternative would be the same as those described for alternative C.

Artifact Curation

We would explore the possibility of deaccessioning many of the World War II and Cold War artifacts and donating them to a regional museum or facility to improve their curation and increase the public access to the collection, resulting in a major beneficial effect on these cultural resources.

Research and Interpretation

Additional efforts, through significant increases in communications and multilingual materials, to bring visitors to the refuge would provide a minor to moderate beneficial effect on interpretation, but possibly a minor to moderate adverse effect on cultural resources in the field (through the removal or overuse of sites). Interpretation of the prehistory and history of the refuge would concentrate on its contextual place in regional prehistory and global history.

Tours of the restored Egli House would provide a history of the home in addition to insight into early settlement and farming in the region.

Further research on the prehistoric sites on the refuge would have a moderate beneficial effect on our current understanding of these resources.

We would appeal to history buffs with programming and materials above and beyond what would be offered under the other alternatives. This additional emphasis on history would have moderate to major beneficial effects on the interpretation of historical resources and events. We would also identify and interpret the location of the 1861 wagon trail, especially where it crosses tour routes. We would offer living history demonstrations, providing excellent opportunities for interpreting the site's history.

We would work with regional partners to better display and interpret the World War II and Cold War history of the refuge in an offsite facility that is not owned or operated by the Service.

Cumulative Effects on Historical and Cultural Resources

We have not identified any cumulative effects associated with current plans.

4.7 Environmental Consequences on Infrastructure and Operations

Alternative A

Existing infrastructure is insufficient to support anticipated increases in visitation. Deterioration of assets is expected to increase over time, constituting a major adverse effect.

Alternatives B, C, and D

Future infrastructure will be developed to support growth and utilize transportation planning tools. There will be a short-term adverse effect associated with construction activities, but there will be a long-term positive effect of appropriate infrastructure to support increased use of the refuge. There are no cumulative effects associated with infrastructure on the refuge.

An increased number of law enforcement officers under alternatives C and D would improve response capabilities for refuge staff, and visitors would be aware of their safety while on the refuge.

Removing facilities not necessary for refuge operations and consolidating administrative operations to new or retrofitted buildings would have a significant beneficial effect on refuge operations by reducing maintenance requirements and resulting in cost savings.

Under alternative D, concessions and partnerships directed toward the co-management of programming and facilities would benefit refuge operations by allowing for the redistribution of staff and greater operational efficiency.

4.8 Environmental Consequences on Access and Transportation

Anticipated changes in the Denver Metropolitan area over the next 25 years from both a land use and a travel demand perspective will greatly influence who visits the refuge and how they get there. DRCOG projects that the local population will grow by 40 percent between now and 2040. Consequently, they also project, the number of congested road miles in the Denver Metropolitan Area will increase by 50 percent. Meeting this increase in auto-based travel demand by increasing road capacity is not feasible from either a cost or environmental perspective. These statistics lead to three important conclusions:

1. The amount of growth in the refuge vicinity and the traffic generated by that growth so far exceeds the amount generated by the refuge under any alternative that the traffic impacts of any alternative will be negligible.
2. The only way to effectively reduce traffic congestion throughout the Denver Metropolitan area is to shift demand away from

single-occupancy vehicles to forms of transit and nonmotorized modes where feasible.

3. As the transportation system surrounding the refuge becomes more multimodal over the next 25 years, the system that provides access within the refuge boundary must be designed and built to integrate all modes of transportation in a manner that maximizes connection to the external networks.

Alternative A

Under alternative A, visitors would continue to experience moderate to major difficulty in locating the refuge due to the lack of signs and uninviting entrance. Furthermore, visitors would continue to be confused by the mix of various way-finding signs within the refuge, leading to lost visitors and visitors potentially entering closed areas, posing the risk of damaging biological resources.

Roads would continue to be maintained both by refuge and U.S. Army staff. With the expected increase in visitation, maintenance and repairs of the refuge road are expected to increase slightly. Because the Wildlife Drive would remain closed to the public except for guided tours, impacts on the road would be minor. Nature trails would experience similar slight increases in visitation and public use. Overall, alternative A would result in a major adverse effect on the visitor experience in the context of transportation and access.

Alternative B

Way-finding signs throughout the refuge would be updated to a unified system to create consistency and ease of use by visitors. A locational map would be readily accessible at the entrance gate. In addition, we would work with our neighbors and partners to improve signage outside the refuge to better direct visitors. These actions would have a major beneficial effect on the visitor experience.

One new modest-sized parking area would be open to the public at Rattlesnake Hill. We would abandon 14.5 miles of administrative roads, and 8.4 miles of roads would be converted to emergency use, resulting in a minor to moderate beneficial effect on wildlife habitat. Two new trails constructed on the southeast and northeast corners of the refuge would have a minor beneficial effect on the overall trail system and visitor experience and a moderate beneficial effect on those local communities through providing them with greater access to the interior of the refuge. Vehicular access to the refuge would continue to be hampered by the uninviting chain link gate, and could adversely affect traffic in neighboring areas (such as Victory Crossing). Road maintenance would increase slightly from current conditions because expected visitation in 2029 under this alternative would be approximately 30 percent greater than projected visitation under alternative A.

Alternative C

In addition to the effects described for alternative B, we would open about 9.3 miles of roads to the public, most notably the closed sections of the Wildlife Drive, more than doubling the amount of roads cur-

Table 18. Miles of roads and new parking areas for each alternative.

| Alternative | Public roads (miles) | New public roads (miles) | Administrative roads (miles) | Abandoned roads (miles) | New parking areas |
|-------------|-------------------------|-----------------------------|---------------------------------|----------------------------|----------------------|
| A | 7.8 | 0.0 | 43.5 | 11.7 | 0 |
| B | 8.8 | 1.0 | 39.7 | 14.5 | 1 |
| C | 17.7 | 10.4 | 30.8 | 14.5 | 8 |
| D | 17.7 | 10.4 | 30.8 | 14.5 | 8 |

Table 19. Miles of nature trails for each alternative.

| Alternative | Current trails (miles) | New trails (miles) | Abandoned trails (miles) | Total trails (miles) |
|-------------|---------------------------|-----------------------|-----------------------------|-------------------------|
| A | 27.1 | 0.0 | 1.3 | 25.8 |
| B | 27.1 | 2.8 | 1.3 | 28.6 |
| C | 27.1 | 11.2 | 1.3 | 37.0 |
| D | 27.1 | 11.2 | 1.3 | 37.0 |

rently open to the public (table 18). In addition, eight new modest-sized parking areas would be built or opened, resulting in short-term adverse effects associated with construction and repair, and long-term costs would increase substantially as visitation would more than double over levels projected for alternative A. We would add 11.2 miles to the trail system (table 19), resulting in a moderate beneficial effect, as some of those trails would be built to allow bicycles. This change would greatly enhance access opportunities for visitors, and the trail system would be designed to allow for greater flow and way-finding. Two new bicycle and pedestrian access points would be added to the south side of the refuge that, along with a trail system in the northwest corner, would have a major beneficial effect on our nearby neighbors. Public vehicular access to the refuge would remain the same, but visitors would now be greeted by a new refuge entrance gate that invites and welcomes the public. In addition, the public could access the refuge from six pedestrian and bicycle access points. These access points, primarily on the south and east sides, would provide a much-needed connection to neighboring communities. While the improved main entrance with its new pedestrian and bicycle access points would have major beneficial effects for the public coming to the refuge, the increased visitation could also lead to traffic congestion for our neighbors (for example, at Victory Crossing). At the same time, this impact could improve business opportunities in that area. Way-finding along the Wildlife Drive and new access points and trails would need to be expanded to include these areas now open to the public. They would be a part of the same unified way-finding system described under alternative B. Some of the more specific effects associated with access and transportation under this alternative are discussed below:

- Improved technological resources (such as our Web site and use of social media) in tandem with more rangers and improved signs and way-finding would better orient visitors and help them plan and enjoy their visit.
- The expansion of the refuge's trail system and new observation and interpretive facilities would benefit visitors by providing access to different types of habitats and accommodating a variety of wildlife-dependent recreational uses.
- Opening some trails to multiple uses (such as biking and walking) may adversely affect visitors who prefer to have the trails restricted to walking only; overall, however, this action would invite more use and expand the enjoyment and appreciation of

the refuge's habitats and wildlife, resulting in a major long-term beneficial effect.

- The expanded trail system would provide increased opportunities for physical activity. Similarly, more convenient access and the addition of bike lanes and bike sharing would result in more physical activity within the refuge and increased exposure to natural environments. These proposed improvements to the refuge would benefit community health while also enhancing the visitor experience, resulting in a major long-term beneficial effect.
- New access points in combination with increased outreach and more wildlife-dependent recreation opportunities would likely result in increased visitation and encourage more repeat visits to the refuge. Although increased visitation and congestion may be construed by some as an adverse effect, on balance, the provision of more and improved access would benefit a larger number of visitors, resulting in a major long-term beneficial effect.

Alternative D

The effects under this alternative would be the same as those under Alternative C, except that maintenance costs would be lower due to the lower number of visitors.

Cumulative Effects on Access and Transportation

Alternative A

We expect that alternative A would result in minor long-term adverse effects as refuge trails remain disconnected from the local trail network, presenting a barrier to public movement.

Alternative B

The effects would be the same as those described for alternative A.

Alternative C

We expect minor to moderate beneficial long-term effects for the public as refuge trails would be better

connected to the local trail network. Furthermore, a unified sign plan developed in coordination with our partners would produce a major long-term beneficial effect on overall visitor experiences.

Alternative D

The effects would be the same as those described for alternative C.

4.9 Environmental Consequences for the Socioeconomic Environment

Overview of Economic Impact Analysis

The refuge brings new money to the local economy through non-local visitor spending, expenditures on refuge management, refuge personnel's salary spending, and RSS payments. Economic impacts are the measure of the economic activity generated through these expenditures.

Economies are complex webs of interacting consumers and producers in which goods produced by one sector of an economy become inputs to another, and the goods produced by that sector can become inputs to yet other sectors. Thus, a change in the final demand for a good or service can generate a ripple effect throughout an economy as businesses purchase inputs from one another. For example, when visitors come to an area to visit a national wildlife refuge, they spend money to purchase various goods and services. The sales, income, and employment resulting from these direct purchases from local businesses represent the direct effects of visitor spending within the economy.

In order to provide supplies to local businesses for the production of their goods and services, input suppliers must purchase inputs from other industries, thus creating additional indirect effects of visitor spending within the economy. Additionally, employees of directly affected businesses and input suppliers use their income to purchase goods and services in the local economy, generating further induced effects of visitor spending.

The sums of the indirect and induced effects give the secondary effects of visitor spending, and the sums of the direct and secondary effects give the

total economic effect of visitor spending in a local economy. Economic input-output models capture these complex interactions between producers and consumers in an economy and describe the secondary effects of spending through regional economic multipliers (USGS 2014b).

For each alternative, regional economic impacts are reported for the following categories:

- *Employment* represents the change in the number of jobs generated in the region from a change in regional output. IMPLAN estimates for employment include both full-time and part-time workers, which together are measured as total jobs.
- *Labor Income* comprises employee wages and salaries, including income of sole proprietors and payroll benefits. For 2015, total labor income for the local eight-county area is estimated at \$136 billion (\$2015) and total employment is estimated at just over 2 million jobs.
- *Value Added* measures contribution to Gross Domestic Product. Value added is equal to the difference between the amount an industry sells a product for and the production cost of the product, and is thus net of intermediate sales.

The economic impacts reported in this analysis are presented on an annual basis in 2015 dollars (\$2015). Large management changes often take several years to achieve. The estimates reported for all alternatives represent the final average annual economic effects after all changes in management have been implemented (USGS 2014b).

Current visitor activities on the refuge include fishing and nonconsumptive uses such as hiking on nature trails, wildlife viewing and photography, driving tours and guided tours, and environmental education and interpretation. Under alternative A, current visitor services programs and facilities would be maintained. These visitor uses would be slightly expanded under alternative B, and would be significantly expanded under alternatives C and D. Under alternative C, an abundance of instructional programming would connect more local residents with nature and wildlife; existing trails would be improved and new trails would be created to facilitate access for pedestrians and connectivity with existing and new regional trails. Under alternative D, as under alternative C, the visitor services program and facilities would be significantly expanded. Whereas alternative C targets improved services for local area residents, alternative D would aim to

appeal to a broader range of visitors and would likely draw a larger number of non-local visitors to the refuge. Fishing and nonconsumptive activities would be available under all alternatives. Hunting is not currently allowed on the refuge, and the refuge would remain closed to hunting under alternatives A and D. Limited quota deer and dove hunts are proposed under alternatives B and C (USGS 2014b).

In 2013, the refuge received approximately 300,000 visits. Under alternative A, annual visits are expected to grow by approximately 2.3 percent each year, resulting in an estimated 420,000 annual visits in 2029 (2029 marks the culmination of the 15-year CCP planning horizon) (appendix D). Under alternatives B, C, and D, visits are expected to grow by approximately 4.4 percent, 8.6 percent, and 4.7 percent annually, resulting in 2029 estimates of 575,000, 1.03 million, and 600,000 visits, respectively (USGS 2014b).

The key mechanisms of economic impacts are described below, and the quantified impacts are shown in table 20.

- *Non-Local Visitor Spending.* To determine the local economic impacts of visitor spending, only spending by persons living outside the local eight-county area are included in the analysis. The rationale for excluding local visitor spending is twofold. First, money flowing into the eight-county area from visitors living outside the local area (or non-local visitors) is considered new money injected into the local economy. Second, if residents of the eight-county area visit the refuge more or less due to management changes, it is likely that they will correspondingly change the spending of their money elsewhere in the local area, resulting

Table 20. Annual economic impacts under the CCP alternatives.

| <i>Metric</i> | <i>Alternative A</i> | <i>Alternative B</i> | <i>Alternative C</i> | <i>Alternative D</i> |
|------------------------------------|----------------------|----------------------|----------------------|----------------------|
| Non-Local Visitor Spending | | | | |
| Visitor-days | 70,000 | 96,000 | 211,000 | 111,000 |
| Jobs | 84 | 115 | 253 | 134 |
| Labor income | \$3,300,000 | \$4,500,000 | \$9,900,000 | \$5,200,000 |
| Value added | \$5,300,000 | \$7,300,000 | \$16,000,000 | \$8,400,000 |
| Refuge Management | | | | |
| Refuge operational budget (FY2013) | \$730,000 | \$730,000 | \$1,450,000 | \$880,000 |
| Jobs | 11 | 11 | 22 | 14 |
| Labor income | \$491,000 | \$491,000 | \$ 988,000 | \$600,000 |
| Value added | \$603,000 | \$603,000 | \$1,196,000 | \$726,000 |
| Capital improvement projects | \$253,000 | \$253,000 | \$489,000 | \$363,000 |
| Jobs | 3 | 3 | 6 | 4 |
| Labor income | \$198,000 | \$198,000 | \$382,000 | \$283,000 |
| Value added | \$240,000 | \$240,000 | \$465,000 | \$344,000 |
| Personnel salary expenditures | \$1,330,000 | \$1,250,000 | \$1,820,000 | \$1,460,000 |
| Jobs | 7 | 6 | 9 | 7 |
| Labor income | \$345,000 | \$326,000 | \$474,000 | \$380,000 |
| Value added | \$586,000 | \$552,000 | \$804,000 | \$645,000 |
| RSS Payments | \$418,000 | \$418,000 | \$418,000 | \$418,000 |
| Jobs | 6 | 6 | 6 | 6 |
| Labor income | \$341,000 | \$341,000 | \$341,000 | \$341,000 |
| Value added | \$454,000 | \$454,000 | \$454,000 | \$454,000 |
| Total Economic Impacts | | | | |
| Jobs | 111 | 141 | 296 | 165 |
| Labor income | \$4,700,000 | \$5,900,000 | \$12,099,000 | \$6,800,000 |
| Value added | \$7,200,000 | \$9,100,000 | \$18,889,000 | \$10,600,000 |

in no net change to the local economy. These are standard assumptions made in most regional economic impact analyses at the local level. Refuge staff estimated the percent of visits made by non-local visitors (USGS 2014b).

Annual visit estimates are on a per visit basis, whereas visitor spending profiles are estimated on an average visitor-day (8-hour) basis. Because some visitors only spend short amounts of time visiting the refuge, counting each visit as a full visitor-day would overestimate the economic impact of refuge visitation. To properly estimate visitor spending, annual number visit estimates were converted to visitor-days. It is assumed that visitors primarily engaged in fishing spend an average of 4 hours on the refuge, visitors primarily engaged in hunting would spend an average of 8 hours on the refuge, and visitors primarily engaged in nonconsumptive uses spend an average of 3 hours on the refuge.

A visitor usually buys a wide range of goods and services while visiting an area. Major expenditure categories include lodging, restaurants, groceries, transportation, and souvenirs. In this analysis we use an average daily visitor spending profile developed from refuge visitor data collected as part of the 2012 National Wildlife Refuge Visitor Survey. Based on this survey, refuge visitors spend an average of \$88.34 per visitor-day. Accounting for average lengths of stay by primary activity, this translates to average visitor expenditures of \$44.17 per fishing visit, \$88.34 per hunting visit, and \$33.13 per nonconsumptive visit.

- *Refuge Operational Budget.* Refuge purchases made in the eight-county area contribute to the local economic impacts associated with the refuge. The refuge incurs both annual (recurring) operational costs and makes one-time expenditures for capital improvement projects, such as improvements to and new construction of trails, roads, and buildings. Many of these purchases are made from businesses within the eight-county area. Refuge employees reside and spend their salaries on daily living expenses in the local area, generating impacts within the local economy.

Recurring annual expenditures include sup-

plies and utilities, habitat and grounds improvements and treatments, equipment maintenance and repair, and auto repairs, parts, and fuel. Only refuge expenditures that are directly spent in the eight-county area are included in the economic impact analysis.

- *Capital Improvement Projects.* One-time expenditures for capital improvement projects include improvements to and new construction of trails, roads, and buildings. Under alternatives A and B, the refuge would make routine maintenance on visitor facilities, roads, and other refuge infrastructure, and would construct a new office and new bunkhouse. Under alternatives C and D, the refuge would make additional visitor enhancements including new trails and interpretive signs and displays. Expenditures on capital improvement projects would be greatest under alternative C, which would include the construction of a new refuge headquarters. Under alternative D, the refuge would rely on commercial ventures (such as concessionaires) along with partners to expand visitor uses and other operations. Average annual capital project costs were estimated by dividing total project costs by 15 years, the planning horizon for the CCP.
- *Personnel Salary Expenditures.* Refuge employees reside and spend their salaries on daily living expenses in the local area, thereby generating impacts within the local economy. In fiscal year (FY) 2013, refuge salaries totaled \$1.33 million. Only household spending within the eight-county area is included in impact estimates.
- *RSS Payments.* Counties with lands owned and managed by the Service qualify for reimbursement under the Refuge Revenue Sharing Act of 1935, which allows the Service to make annual payments to local governments in areas where fee title purchases have removed land from the tax rolls. Payments are based on the greater of 75 cents per acre or 0.75 percent of the fair market value of lands acquired by the Service. The exact amount of the annual payment depends on Congressional appropriations, which in recent years have tended to be substantially less than the amount required to

fully fund the authorized level of payments. In FY13, actual RRS payments were 25.3 percent of authorized levels. Adams County is compensated for refuge land, and in FY2013, RRS payments to Adams County totaled \$418,000.

4.10 Irreversible and Irretrievable Resource Commitments

NEPA requires a discussion of any irreversible or irretrievable commitments of resources that would result from implementing various alternatives. An irreversible commitment of resources means that nonrenewable resources are permanently lost because of CCP implementation. In contrast, an irretrievable commitment of resources is the short-term loss of resources or resource production, or the loss of renewable resources.

All the alternatives, including the no-action alternative, would result in some irreversible loss of soil resources. Depending on the final location of proposed

facilities, topsoil could be removed before the facilities' construction (primarily under alternatives C and D), but could be reused in revegetation of disturbed areas. Even with the best management practices, some irreversible soil loss from erosion could occur.

Removal or disturbance of any unknown cultural resources would result in irretrievable and irreversible loss of resources.

Increased emissions from refuge operations could exceed Federal or State air quality standards, but only for a short time. For example, a prescribed fire may exceed 1-hour PM standards but would probably not exceed 24-hour standards. Air quality would return to existing conditions following prescribed fire and other disturbances that result in increased dust or other emissions. Increased visitor access on refuge roads would not affect regional air quality.

Construction of new or expansion of existing trails across and near the refuge would represent a change in the function and production of the vegetation along the trail's path, and would constitute either irreversible or irretrievable commitment of resources—depending on whether the trail is paved—because their use would be temporarily or permanently lost for future generations.



Cindy Souders / USFWS

The use of prescribed fire would result in short-term losses of vegetation.

4.11 Short-Term Uses of the Environment and Maintenance of Long-Term Productivity

Short-term factors associated with implementing the CCP include (1) construction, realignment, or refurbishment of facilities or fences; (2) improving and maintaining roads; and (3) building new or renovating existing facilities to support visitor services.

Implementing the final CCP, including restoration of disturbed lands to native vegetation, management activities such as prescribed fire, control of wildlife populations, and the control of invasive species, would contribute to the maintenance and enhancement of long-term productivity of the refuge environment. Long-term restoration factors associated with implementing the CCP include (1) restoration of former agricultural, military, and industrial areas; and (2) restoration of the First Creek riparian corridor.

4.12 Unavoidable Adverse Effects

Most negative (or adverse) environmental consequences associated with implementation of the CCP would be short term and minimal, but some long-term adverse effects could occur.

During construction of the new headquarters and other facilities on the refuge under all alternatives, habitats and wildlife would be disturbed and temporarily displaced. This construction would also result in minor, short-term disturbance of soils, and erosion could lead to a spread of invasive species if control measures are not in place. The removal or modification of infrastructure, such as dams, would result in minor, short-term disturbance of soils and erosion, resulting in minor to moderate long-term changes to vegetation, soil chemistry, and presence and use of wildlife species and populations.

The use of prescribed fire would result in short-term losses of vegetation. There is always the potential for prescribed fire to escape the refuge boundary and burn onto private lands, resulting in unavoidable adverse effects. By following prescribed fire plans, maintaining fire breaks, and using approved fire prescriptions, the risk of prescribed fires escaping the established parameters would be greatly reduced.

Overall, implementation of the CCP under alternatives B, C, or D would result in long-term benefits ranging from minor to major for the biological com-

munity and the diversity and productivity of the refuge. Full restoration of former agricultural, military, and chemical production areas on parts of the refuge would increase the amount of native vegetation. Deer hunting on the refuge would result in adverse effects on individual deer but would result in minor to moderate long-term benefits for the overall population by increasing its stability and sustainability. We would expect temporary, minor impacts on the refuge's dove populations from implementation of hunting of these species on the refuge.

The use of prescribed fire on the refuge could adversely affect some wildlife species. Burns during the nesting season would be most detrimental to birds and small mammals, depending on the uniformity and severity of the burn and the ability of the bird to re-nest. In 2014, the refuge applied prescribed fire to a total of about 1,700 acres (including lands owned by the U.S. Army). Under the no-action alternative, the refuge anticipates using prescribed fire on up to about 2,500 acres per year. While the use of prescribed fire would vary from year to year based on management objectives, funding and staffing, weather conditions, and smoke management, prescribed burning would not be significantly increased under any of the action alternatives. Careful consideration of the timing of fires would limit adverse effects on bird species.

Under all alternatives, limiting visitor access to the bald eagle nesting and critical habitat zone during the nesting season would continue to benefit this species. Allowing for a moderate increase in compatible wildlife-dependent uses, particularly under alternatives C and D, could adversely affect some individual eagles. Similarly, the action alternatives are expected to result in beneficial or neutral effects for threatened and endangered species and other species of concern.

While most actions identified for cultural resources would largely be beneficial, some unavoidable adverse effects could occur if undiscovered cultural resources were to be damaged by refuge activities. Under all alternatives, adverse effects on historic properties (resources eligible for inclusion in the NRHP) would be avoided whenever possible. In cases where an adverse effect on a historic property is unavoidable, consultation under Section 106 of the NHPA would be conducted to resolve the adverse effect. In spite of increased monitoring, more survey work, and law enforcement presence, some significant cultural resources could be stolen as a result of increased access, constituting an unavoidable adverse effect.

4.13 Conflicts with Federal, State, Tribal, or Local Agencies

Generally, the actions considered in this EIS do not appear to specifically conflict with the missions, goals, or other management plans of the FHWA, EPA, NPS, CPW, APHIS, Adams County, City of Commerce City, City and County of Denver, DIA, Colorado Department of Transportation, Tri-County Health Department, UDFCD, or Denver Water. The proposed reintroduction of the black-footed ferret onto the refuge garnered great interest from these and other agencies and municipalities. There is concern that incidental take of individual reintroduced ferrets could trigger ESA-related law enforcement actions. We have been working closely with our neighbors to alleviate those concerns, which are described in the biological opinion for ferret reintroduction (see appendix F).

We work closely with CPW on a range of issues related to hunting, fishing, and wildlife management.

The State of Colorado is responsible for mitigating wildlife impacts on neighboring private lands. CPW supports providing hunter's safety education and hunting opportunities on the refuge.

We are not aware of any conflict or issues with Native American tribes who have aboriginal interests in the refuge site. Should any issues with Native American tribes arise, we would begin consultations to resolve the issues in a mutually beneficial way.

4.14 Comparison of Environmental Consequences

Table 11 in chapter 2 summarizes the environmental consequences identified in this chapter for all alternatives.